THE EFFECTS OF INITIALLY HIGH ERROR TASKS ON SHORT TERM LEARNING FOR MILDLY HANDICAPPED STUDENTS

BY

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Abstract of Dissertation Presented to the Graduate School of The University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

THE EFFECTS OF INITIALLY HIGH ERROR TASKS ON SHORT TERM LEARNING FOR MILDLY HANDICAPPED STUDENTS

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This investigation compares the learning of mildly handicapped students in initially low and initially high error environments. It studies the effects of curriculum leap-ups on short term learning rates. A curriculum leap-up is defined as an upward curriculum change that results in a student making at least 10% more errors than correct responses. The dependent measures are celerations for correct responses and errors, improvement index, accuracy improvement, and fluency. Frequency (movements per minute) is the basic measure for all the dependent variables.

Single subject designs are used to compare the learning rates of students on preleap-up skills with leap-up skills. Both a Leap and Keep and a Leap and Leave Design are used. The Leap and Keep design involves continuing the preleap-up skill when the leap-up skill is introduced. The Leap and

Leave design involves dropping the preleap-up skill when the leap-up skill begins.

Sixteen students in elementary and middle school resource room programs were included. The students ranged in age from seven to fourteen. Both reading and math leap-ups were used.

Twenty-four of twenty-nine experiments produced effects favoring learning during the leap-up condition. In most experiments celeration for correct responses and errors, the improvement index, and accuracy all increased. Findings for fluency were mixed.

Results were replicated across subjects, skills, teachers, and settings. Implications for future placement and instruction, and recommendations for continuing research are presented.

CHAPTER I

INTRODUCTION

The problem addressed in this study is the relationship between task difficulty and learning outcomes. A review of recent history and the status of programs for mildly handicapped students indicates that what is done instructionally for the mildly handicapped occurs in the context of instructional protectiveness. There is a tendency to avoid placing students in high expectation situations where they might encounter failure (Meyen & Lehr, 1980). The consequence of this protection from possible failure may also limit opportunities for growth. The use of teaching strategies that fail to challenge students may play a part in accounting for some of the failures and limited successes of programs for the mildly handicapped.

Traditionally, instruction in special education has differed from regular education in the use of several important teaching strategies. These strategies include allowing extra time for students to complete their academic assignments, moving more slowly through curriculum sequences, and giving them curricular material on which they achieve initially low error rates. It is obvious that these strategies have both the potential of protecting the learner

from failure, but also of limiting growth. These strategies may also provide indirect messages to learners that could affect their self-concept and general motivation for academic learning. This research explores one of these issues by studying the learning of mildly handicapped students taught in both initially low and high error instructional environments.

Significance

There are indications that special education is ineffective and inefficient in fostering learning for the mildly handicapped student (Dunn, 1968; Semmel, 1979). Although, there has been a concerted effort by some educators (Deshler, Shumaker, Alley, Warner, & Clark, 1982; Englemann & Carnine, 1982) to develop more effective teaching methods, common practice is that special educators have become overly concerned with the labeling and placement of special education students, rather than in looking for methods that foster their learning.

Conclusions from a six-year study of the performance of over 1300 mildly handicapped students (Neely, 1978) revealed that using teaching strategies which allowed the students to make some errors initially and charted daily performance was the most effective way to improve student learning rates. The students' label or whether or not they were taught in special education settings or regular classrooms had no direct bearing on their learning rates. Yet Neely found,

that in the three school districts he surveyed, the majority of time and effort was spent on the labeling of students and deciding on their placement, rather than on training teachers in using charting and teaching strategies to promote high rate learning.

After looking at the current teaching practices in special education classrooms, Glazzard (1984) recommended that special educators should restructure these settings to make them more like general education classrooms. She concluded that in many classrooms special education teachers are limiting the academic growth of their students by continually giving them academic material which is too easy. Also, because of a tendency to use teaching strategies that protect students from failure and emphasize immediate reinforcement, teachers may be limiting the generalization of skill learning to regular classroom settings.

Howell, Kaplan, and O'Connell (1979) point out that many of the popular methods for teaching handicapped students actually guarantee that they will remain behind their peers rather than emphasizing strategies that allow special education students to "go like mad" in order to catch up.

In an effort to implement appropriate instructional programs to meet individual needs, teaching strategies that challenge the learner may have been overlooked by special educators. In many cases the consequence of this may be passive learners who never reach their potential. It may be that our emphasis should be on devising teaching strategies

that promote rapid learning of material closer to the student's grade placement and potential. There are at least three advantages of rapid learning. One, it allows the special student a good chance of mastering everything which is essential for competing with other students. Two, it raises the special student to the criteria of regular students so that there is no built-in guarantee of future failure. Three, it allows the student, maybe for the first time, to experience the joy of new learning.

Tawney and Gast (1984) note that the field of special education faces greater challenges today than it has at any other time in the past. The altruism that provided past impetus for special education programs is gone. Arguments for programs based on equal opportunity interpretations of the Constitution have been overshadowed by the decline of the economy. Programs for the handicapped are increasingly being called upon to justify their existence. Only by implementing a technology of education that uses student learning as a basic datum for justifying its existence can special educators become more accountable to parents of handicapped students and to the public at large. As part of this accountability it is imperative that special educators prove that they have the strategies to help students learn faster and the data to show how it is being done.

Rationale

There is little research on the learning of handicapped students who are given academic tasks with initially high error rates. As an outcome of this special education may be producing students who fail to develop high rate learning skills (the skills that are associated with making many errors initially but reducing them quickly), or stay on the same skill level for long periods of time without making gains or reaching proficiency levels.

A rapidly developing technology of teaching and learning, Precision Teaching (See Appendix A for a definition), is making it possible for teachers to begin to accumulate data on student learning rates. Average classrooms in America produce around 10% learning per week (O.R. Lindsley personal communication August, 1981), while classrooms that are precision taught average around 25% per week learning (R. Beck personal communication March, 1980) and there are data to show that some precision teachers continually produce 100% learning per week (W.D. Wolking personal communication May, 1983). But even precision teachers fell into the "easy task" approach to teaching exceptional students. McGreevy, Thomas, Lacy, Krantz, and Salisbury (1982) report that for many years precision teachers charted student performance, while continuing to implement traditional public school curricular strategies. These strategies produced initial correct performances that were relatively high with very few incorrect responses (high

accuracy), but subsequent rates of learning remained relatively low.

Few teachers introduce skills at levels that provided high error rates. Yet it is at these levels that intensive teaching is most appropriate if students are to experience academic growth. Teaching skills on which accuracy is already high places an emphasis on practice, requiring little of the teacher, other than that opportunities for practice are provided. This type of teaching has the potential of developing bored teachers who become frustrated by the lack of progress of their students. It may also contribute to the high rate of burn-out during a teacher's first few years in the classroom (Wells, Schmid, Algozzine, & Maher, 1984).

In 1978, Lindsley (cited in McGreevy, 1980) began to question the effectiveness of curricular strategies that emphasized highly accurate initial performance and apparently provided less opportunity for learning. Neely (1978), one of Lindsley's students at Kansas, analyzed student learning from four different teaching strategies over a six year period. Results indicated that giving students tasks with initial error rates at 5 to 10 per minute was more effective at producing steeper error decelerations than was giving students tasks with initial error rates below 5 per minute. His study fell short of gathering any conclusive data on another teaching strategy, that of giving students tasks with the initial errors above

the correct responses, because teachers were reluctant to teach this way in many cases. However, other precision teachers (Bower & Orgal, 1981; Eaton & Whittman, 1982; McGreevy, 1978, 1980; Stromberg & Chappel, 1980) then began to look at the initially high error or leap-up teaching strategy (with initial errors above the correct responses) and data began to accumulate that showed steep celerations for both correct responses and errors resulted when this strategy was used.

The investigator in this study became interested in the leap-up teaching strategy for two reasons. First, it is a means for motivating a large group of mildly handicapped students who were making slow progress in special education classrooms. Second, it is a way of training graduate practicum students to use high error teaching strategies in teaching academic skills. The opportunity to investigate the strategy was aided by the fact that graduate practicum students at the university are trained in precision teaching.

Statement of the Problem

Many special education students fail to make gains or improve very slowly on academic tasks that have initially low error rates. This study explores the relative effects of initially low and high error teaching environments on four dimensions of student performance and learning. A

change from low-to-high error rates, while holding other features as constant as possible, is called a leap-up.

This study extends the work on leap-ups or high error learning by (1) further quantifying the definition of a leap-up first used by McGreevy, Thomas, Lacy, Krantz, and Salisbury (1982), (2) identifying two kinds of leap-ups, (3) extending the sample studied to include elementary age mildly handicapped students, and (4) including more work on reading skills.

The design of this investigation is single subject. The teaching strategy of a curricular leap-up is used with students who are not meeting performance standards or who are working on skills below their grade level or both.

Question Under Investigation

This study examined the effect of curriculum leap-ups on four dimensions of academic performance. The major concern in this study was a comparison of rates of learning under preleap and leap-up conditions. Celeration for corrects and errors, improvement index, and accuracy improvement were compared for the preleap-up and leap-up conditions. Fluency measures were also reported. Definitions of these four measures are listed in Appendix A. Also, a more detailed explanation and a graphic display of their meanings are presented in Chapter 3 under the Measurement section and in Figure 3.

The following question was investigated: What are the effects of leaping-up to tasks that initially produce at least 10% more errors than correct responses, on celeration, improvement index, accuracy improvement, and fluency? (See Chapter 3 for definitions of pre- and post-leap-up phases.)

Delimitation

The subjects in this investigation are elementary and middle school mildly handicapped students; therefore the findings cannot be generalized without systematic replications to mildly handicapped high school students or to normal high school students.

Definition of Terms

Many technical terms from precision teaching and behavior analysis were used in reporting this investigation. Some of the terms where introduced in this chapter and others will be introduced throughout the study. The terms have all been defined in Appendix A; so the reader may refer to them as needed.

CHAPTER II

REVIEW OF RELATED LITERATURE

This review has two sections. The first section reviews the literature from Precision Teaching on high error learning usually conceptualized under the label of curriculum leap-ups. The second section reviews relevant research and theory on learning with initially high errors from the published work of behavior analysts and learning theorists.

Studies from Precision Teaching on Learning Tasks with Initially High Error Rates/ Curriculum Leap-Ups

To complete this section all the articles from the Journal of Precision Teaching and "All the Known Precision Teaching/Standard Chart References" (Eshleman, 1983) were reviewed. "All the Known Precision Teaching/Standard Chart References" is a database of over 700 references pertaining to precision teaching and/or standard celeration charting. It spans the years of 1965 to the present. The database was compiled from all the published and unpublished sources in precision teaching that the author could locate. The references in the database include those found through an ERIC search, journal sources, private sources, presentations from Precision Teaching Conferences and presentations from

the Applied Behavior Analysis conferences that dealt with precision teaching. Much of the literature from Precision Teaching is in the form of unpublished work and personal communication because O.R. Lindsley has promoted this approach to professional communication in building a research base. All the Known References from Precision Teaching is continually being updated in order to provide a research base for those conducting research in the Precision Teaching field.

The major concern in this investigation was the rate of learning tasks under initially high and initially low error conditions. Precision Teachers have always been interested in the provision of curricular and other environmental arrangements that accelerate the mastery of skills (Bower & Orgal, 1981). When data began to accumulate that showed that tasks with initially high error rates provided more opportunities for learning (Neely, 1978), the field began to address the issue. It first looked at tasks that were initially hard to learn (had high error rates) and then moved to the leap-up concept which involves "leaping a student up" to more difficult material.

Seven studies were located that addressed the issue of giving students tasks with initially high error rates or of giving them curriculum leap-ups in an attempt to accelerate learning. Table 1 presents a description of these studies beginning with the earliest and moving up to the most recent.

Table 1

Review of Selected Studies on Learning Tasks
With Initially High Error Rates/Curriculum Leap-Ups

Author(s)	Subjects	Invervention	Measures	Results	Conclusions
Neely (1978)	1300 special education students	1. Different curricula 2. Different teaching strategies.	1. Frequencies for correct responses and errors. 2. Celerations for correct responses and errors.	1. Curricula that allow higher initial error rates produce higher rates. 2. Teaching strategies that emphasize reducing errors produce higher error decelerations.	1. Special Education Students should be given materials with high error rates. 2. Teaching strategies that emphasize teaching to errors should be used to increase learning.

Table 1

Continued

Author(s)	Subjects	Invervention	Measures	Results	Conclusions
McGreevy (1978)	122 mildly handicapped students	1. Screening tasks for 10 days w/o instruction. 2. Resource teacher remedial program with instruction.	1. Initial frequencies for corrects. 2. Celerations for corrects.	1. Screening tasks produced lower initial correct frequencies and higher correct celerations. 2. Remediation tasks produced high initial correct frequencies but low correct celerations.	Remediation efforts were relatively ineffective for this group of students because the tasks were too easy.
McGreevy (1980)	(1) moderately retarded boy	See/say task Wilson's sight vocabulary (29) words) high initial error task.	1. Initial accuracy ratio 2. Celeration for correct responses and errors.	1. Initial accuracy ratio /19 2. Cel for corrects x2.6. 3. Cel for errors /12.6.	The task was initially "hard to do" but proved to be "easy to learn."

Table 1

Continued

Author(s)	Subjects	Invervention	Measures	Results	Conclusions
Stromberg & Chappel (1980)	Regular Second grade students	1. O.P.T. timing of second grade math operations Following the curriculum steps (probes). 2. Leap-Up to all of the 2nd grade curriculum at one time (mixed probes).	1. Initial accuracy ratios. 2. Median correct celerations. 3. Median error celerations.	<u>Intervention #1</u> 1. Initial accuracy ratio x1 to x65. 2. Median correct celeration x1.4. 3. Median error celeration x1.0. <u>Intervention #2</u> 1. Initial accuracy ratio x6 to /1.6. 2. Median correct celeration x2.0. 3. Median error celeration /2.4.	The presentation of all the math curriculum at one time was "hard to do" but "easy to learn."

Table 1

Continued

Author(s)	Subjects	Invervention	Measures	Results	Conclusions
Bower & Orgal (1981)	College students enrolled in an undergraduate psycology class (3 groups).	1. High aims for correct responses set (40 per minute) when learning psycology terms. 2. High initial performance with few correct many errors presented as a model for class. 3. Snapping fingers at 60 per minute during timings in class. 4. Consequating any correct answers. 5. Setting grade criteria as only the number of correct responses.	1. Frequencies for correct responses & errors. 2. Learning pictures generated.	1. All three groups produced more errors than correct responses. 2. Majority of learning pictures were jaws or crossovers.	1. Attention to errors may retard the rate at which people learn. 2. Students can enjoy high error learning situations.

Table 1

Continued

Author(s)	Subjects	Invervention	Measures	Results	Conclusions
McGreevy, Thomas, Lacy Krantz. & Salisbury (1982)	24 severely handicapped students	1. 66 tasks that were "hard to do" or "extremely hard to do" were chosen for students on the basis of high initial error rates. The initial error rates had to be at least 10% more than the correct responses. 2. Daily timings & teaching of the tasks by classroom teachers.	1. Initial number correct. 2. Initial number incorrect. 3. Initial Accuracy ratio. 4. Celeration for correct responses. 5. Celeration for errors. 6. Bounce around correct celeration. 7. Bounce around celeration for errors.	1. Inital number correct Median = 1 Range = 0-15. 2. Initial number incorrect Median = 9 Range = 2-54. 3. Initial accuracy ratio Median = 16 Range x1.5-128 4. No relationship between how difficult the task was (low initial performance) & learning or variability.	Neither learning nor variability can be predicted from low initial performance.

Table 1

Continued

Author(s)	Subjects	Invervention	Measures	Results	Conclusions
Eaton & Wittman (1982)	3 junior high L.D. students	Curriculum Leap-Up	Celerations for correct responses and errors.	Leap-Up skills produced higher learning rates for all 3 students when compared with preleap-up skill learning.	Leap-Ups are an effective strategy for motivating students and increasing learning.

The earliest study that looked at errors as learning opportunities was reported by Neely (1978). The basis for this study was the analysis of six years of data on the learning of students in special education programs. Approximately, 62,820 celerations and 630,000 frequencies were collected from 1300 mildly handicapped students. The analysis looked at three aspects of educational practice. The aspects were a description of reading, the effects of curricula on learning, and the effects of teaching strategies on learning. The last two aspects of this investigation dealt with initial error rates and relate to the hard-to-do or leap-up concept.

The results of the analysis across different curricula and teaching strategies indicated that curricula materials that provided students with high initial error rates promoted higher rates of learning than those which had students beginning with relatively few errors. There were also preliminary data that suggested crossover learning pictures (where the errors are initially higher than the corrects) were the most desirable learning pictures to aim for because they produced the fastest learning. Crossover learning pictures were also the most difficult to get teachers to try.

In conclusion, Neely suggests that students are being cheated out of a appropriate education if curricula and teaching strategies that promote rapid learning are not implemented in special education classrooms. Choosing a

curricula which has an initially high error rate, viewing errors as learning opportunities, and the daily charting of performance were seen as the most efficient ways to meet high rate learning goals. Further, his study indicates that most basal reading series do not support the concept of high error learning; rather they support the idea that a student needs to be 90-95% correct when initially "learning" a new task.

In 1978, McGreevy conducted a two-year study that examined the effectiveness of a remedial resource program which used a traditional "easy skill" approach. One hundred and 22 students labeled as mildly handicapped were involved in the investigation. Seventy five of the students were administered a one minute see-say reading task, and 47 of the students were administered a one minute see-write math task. This was done for ten days. The content of these tasks was grade level specific and corresponded to the district curricula in which the students lived. Initial error rates on these tasks were relatively high. Each day, after the one minute timing, the students were made aware of their errors and verbally supplied with the answers, but no instruction was given.

The students were later placed in a remedial program and their progress was monitored with the use of daily timings on remedial reading and math tasks. For reading it was found that students learned more during the screening phase without instruction than they did during the

remediation phase. For math, the results showed the same amount of learning had taken place during both phases.

Conclusions drawn from this study were that the easy tasks used during the remedial program did not allow enough room for growth (initial errors on the tasks were too low), and that the remedial program was ineffective in providing for a high rate of learner change. This appears to be a common occurrence in many programs where students are placed on relatively easy skill levels as a means of "remediating their skill deficits." They frequently make slow gains because of the "easy task" approach.

In McGreevy's (1980) second project, an eighteen year old moderately retarded boy was given a see-say task (see the word, say the word) on the first 29 words of Wilson's essential vocabulary. The initial frequencies indicated that the task was very difficult for the student--he began by making many more errors than corrects. But he learned the task easily--his correct rate went up quickly and his error rate went down quickly. In other words, the task was "hard-to-do" initially, but "easy-to-learn."

Stromberg and Chappell (1980) attempted to teach an entire second grade class a math curriculum at a pace suggested by the adopted math text. Pairing the text with precision teaching methods (daily timings and the use of probes) resulted in the students achieving initially high correct rates while they made almost no errors. The students learned the material at an acceptable rate. After

4 months the investigators "leaped-up" the entire class to all the math operations contained in the second grade math book by giving the students mixed worksheets (problems with all the operations to be learned in the second grade on them). This leap up in curriculum produced lower initial performance for correct responses with the students making a lot of errors. However, results of learning measures indicated that the students learned the material very rapidly. Conclusions were that following logical curriculum sequences may unnecessarily slow students down, and that students should be challenged to see how fast they can learn.

Bower and Orgal (1981) used the concept of high error learning with college students. They set very high aims for the students to meet in learning psychology terms. The students were told to learn all the terms at one time and not to be concerned with their high initial error rates. Results indicated that the students' high initial error rates led to steep celerations (rapid learning) and satisfactory accuracy and fluency rates at the end of the course. Conclusions were that students can learn to view errors as learning opportunities instead of something to be avoided.

Another investigation by McGreevy, Thomas, Lacy, Krantz, and Salisbury (1982) found that neither learning nor variability can be predicted from low initial performance by students. These conclusions were based on the data from the learning of difficult tasks by 24 severely handicapped students over a four week period. In order to qualify as a

difficult task, there had to be at least 10% more errors than correct responses on the initial timing the student took on a task. Sixty-six tasks met this criterion and were then divided into those that were hard-to-do and those that were extremely-hard-to-do depending on how many errors the student initially made on them.

The results of several comparisons between the two groups of tasks clearly indicated that, although the difficulty range varied within the range of hard tasks, there was no relationship between how hard the task was initially and the rate of learning or variability (bounce of the performance). The students learned all the tasks at fairly high rates even when they began with only one or two corrects and many errors.

The most recent investigation which used the leap-up approach was done by Eaton and Wittman (1982). This investigation examined the effects of the leap-up teaching strategy on the learning rates of three learning disabled junior high school students. All three students were accurate in performance of the multiplication and division tables but were not meeting fluency aims (not doing the problems quickly enough). They were considered "reluctant learners" by the investigators who wanted them to move more quickly through the math curriculum. When they were given a leap-up to fractions where their initial error rates were high, they all responded well by increasing their rate of learning. Eventually they all began to meet fluency aims.

Conclusions were that the leap-up approach appears to be an effective way to motivate students with slow growth learning and that special education teachers should guard against using small curriculum steps in teaching students who are not meeting fluency aims.

Studies from Applied Behavior Analysis and Learning Theory on Learning Tasks with Initially High Error Rates

The intent in this section was to review teaching strategies from the applied behavior analysis and learning theory that allowed mildly handicapped students to experience learning tasks with initially high error rates, or tasks that were hard for them in the beginning stages. A computer search using the key words applied behavior analysis, learning theory, high error learning, difficult tasks, teaching strategies, curriculum strategies, mildly handicapped students (EM, LD, BD) was done. Also, a search using the same key words was done in the Exceptional Child Index, CIJE, Education Index, and the Annual Review of Psychology for the years 1974 to 1983. No studies were located.

Since the first searchers were unproductive, a search of the titles in the table of contents was completed for the Journal of Learning Disabilities, LD Quarterly, Teaching Exceptional Students, The Journal of Applied Behavior Analysis, and Exceptional Education Quarterly. This search reviewed titles from these journals for the years 1975 to

present. The same key words as in the computer and indices searches were used. Again, no studies were located.

It appears there is little, if any, research on this topic.

Summary

Research evidence that normal learners as well as handicapped learners have more opportunities for learning when they are placed in "high error" generating situations is beginning to accumulate. Precision teaching techniques that emphasize this approach are curriculum leap-ups and hard-to-do tasks. There is growing evidence that these strategies may be successful with handicapped and nonhandicapped students as well as with adults.

The hard-to-do or leap-up approach to learning represents a change from the traditional approach of giving students tasks with initially low error rates. Studies using precision teaching have shown that (1) errors can serve as learning opportunities, (2) curriculum leap-ups and hard-to-do tasks are effective ways of increasing student performance, (3) motivation for learning may be improved by giving "reluctant learners" curriculum leap-ups, (4) teaching and learning in initially high error learning environmental need further study.

A search of the research literature from Applied Behavior Analysis and learning theory failed to locate any

studies which looked at the learning of mildly handicapped students in high error environments.

Continued research in naturalistic settings is needed to validate strategies that promote initially high error learning. Special educators need to expand their knowledge of the motivating factors of hard-to-do tasks for populations of students who are accustomed to being presented relatively easy tasks under the guise of remediation and protection from failure and its pressures.

CHAPTER III

METHOD

This work attempts to advance the understanding of teaching and learning under high initial error conditions while teaching mildly handicapped students. This experiment investigated the effects of curriculum leap-ups on four learning outcomes. Specifically, the effects on celeration, improvement index, accuracy improvement, and fluency were explored. The study was a series of clinical investigations conducted in ongoing classrooms with graduate practicum students serving as teachers.

Setting

The study was carried out in Alachua County, a north-central Florida school district of 22,000 students. The system has special education resource and/or self-contained rooms in all elementary and middle schools. The data were gathered by the investigator and by graduate students as part of their practicum assignment in resource rooms for the mildly handicapped. The typical student teacher was individualizing instruction on about 25 separate skills at any one time. The skills that were taught were chosen to

satisfy the Individual Education Plan (IEP) for each students as determined by the special education teacher and the student teacher jointly. Teaching procedures were selected with the idea of maximizing student learning.

Subjects

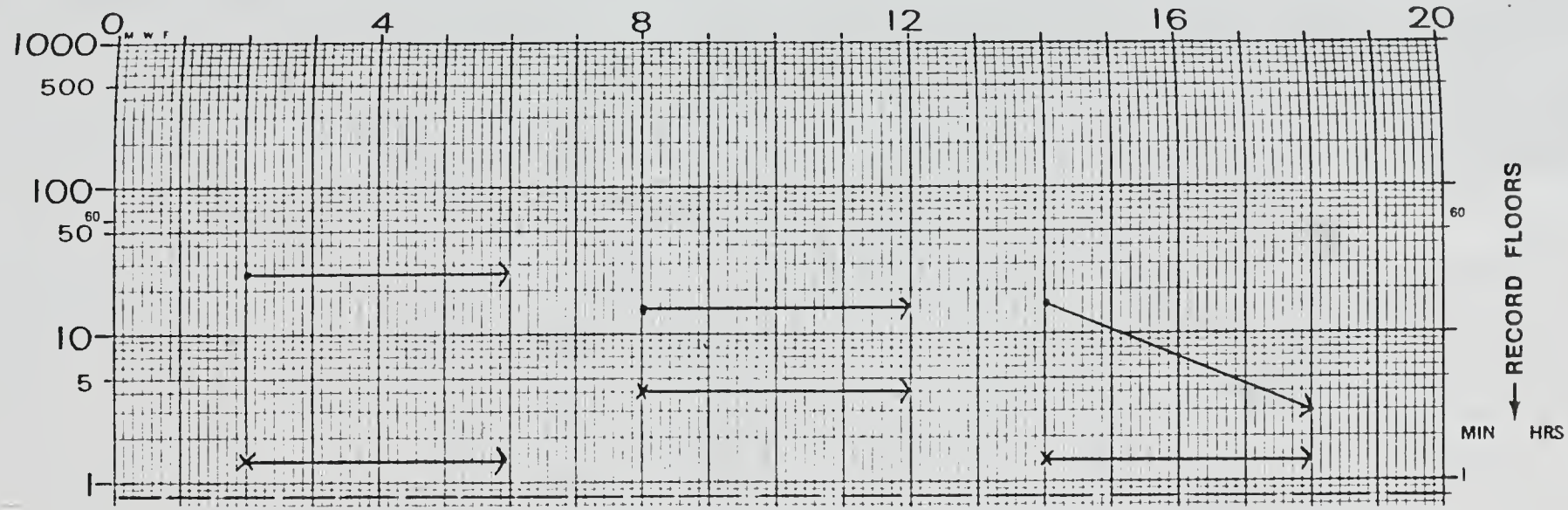
There were sixteen subjects in this investigation. The subjects were all learning disabled, emotionally handicapped, severely language impaired, or educably mentally retarded students. They ranged in age from 7-14. Ten were males and six were females. One subject attended a self-contained program for the severely language impaired, five attended an elementary school resource room program for the mildly handicapped, and ten attended a middle school resource room program for the mildly handicapped. See Table 2 for demographic data on the subjects. All subjects in the study met the Department of Education and the local school district special education placement guidelines (See Appendix B).

Subjects chosen to participate in the experiments met the criteria for type one or type two leap-ups or both. See Figures 1 and 2 for the rationale and criteria for each type of leap-up. Type One leap-ups were used with learners who were making little or no progress in meeting performance standards. Type Two leap-ups were used to allow students working on below grade level skills to experience learning at or near their grade level placement.

Table 2

Demographic Data for Subjects

Subject	Sex	Grade	Exceptionality	Age	Race	Teacher
1. L.A.	M	7	L.D.	12	W	W.O.
2. Y.B.	F	7	EMR	13	B	S.B.
3. C.B.	M	7	L.D.	13	W	B.M.
4. E.B.	M	2	Lang Imp	8	W	M.G.
5. A.F.	M	7	SLD	12	B	W.O.
6. J.R.	F	6	E.H.	12	W	B.M.
7. R.J.	F	7	EMR	13	B	S.B.
8. C.J.	F	8	EMR	14	B	S.B.
9. A.K.	M	2	EMR	8	B	J.R.
10. D.P.	M	5	L.D.	11	B	C.F.
11. N.R.	F	8	L.D.	14	B	C.F.
12. G.R.	M	7	L.D.	13	W	B.M.
13. O.S.	M	6	L.D.	12	B	B.M.
14. W.T.	F	1	EMR	7	B	J.R.
15. E.C.	M	6	E.H.	12	W	B.M.
16. J.V.	M	5	E.H.	11	W	S.L.



Rationale: To motivate students who are not reaching aims or performance standards on skills. These are students with medium to high accuracy, but maintaining or slightly worsening learning pictures (see A, B, C above).

Criteria for Leap-Ups:

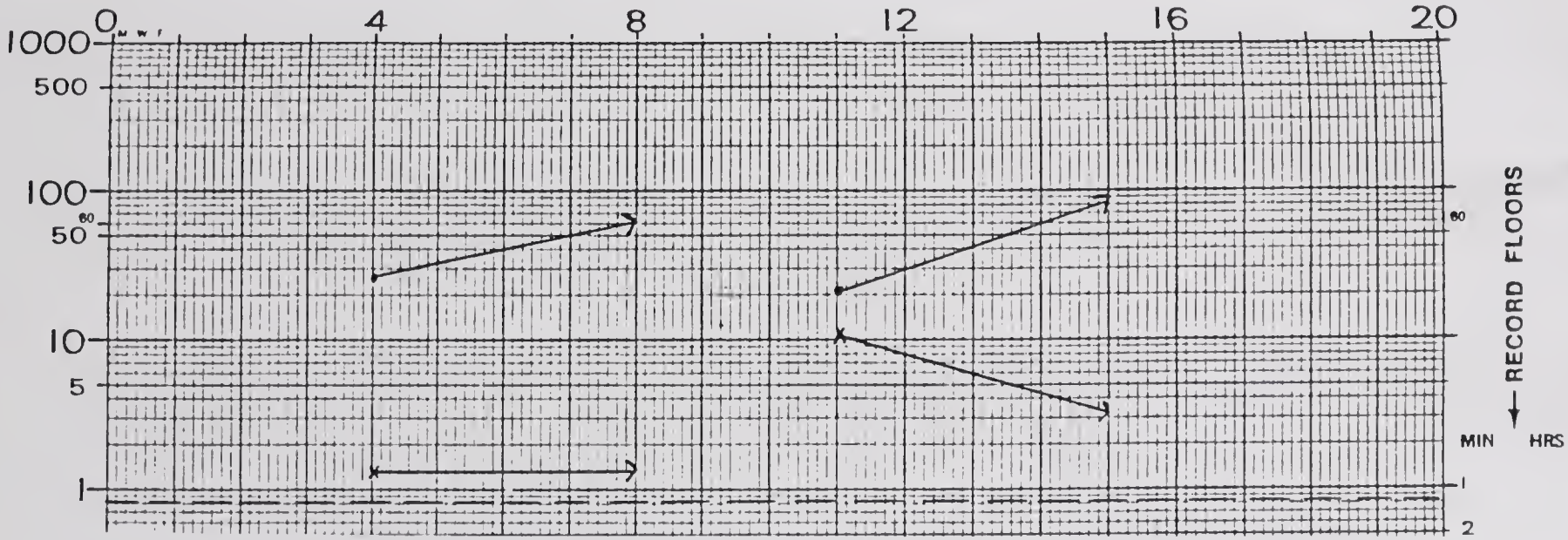
Preleap-Up Phase

1. Medium to high accuracy with low growth for corrects (celeration $\leq$ X 1.15).
2. Corrects not at aim: Reading $\leq$ 100 words p.m. Math $\leq$ 50 digits p.m. Spelling $\leq$ 50 transitions p.m.
3. Low growth errors--errors at aim or celeration $\leq$ /1.15.

Leap-Up Phase

1. First day accuracy ratio $\leq$ 1.1 (at least 10% more errors).
2. If the accuracy ratio is not met, try a larger leap.

Figure 1. Type One Leap-Ups: Slow Growth.



Rationale: To motivate students who are working on skills below their grade level. These students may be reaching performance standards on lower level skills, but they need to experience learning skills above their grade level. Students have improving learning pictures with slow growth or acceptable growth and medium to high accuracy (see D, E above).

Criteria for Leap-Ups:

Preleap-Up Phase
1. High accuracy with slow or acceptable grwoth for corrects (celeration $\leq$ X 1.15).
2. Corrects at or near aim for skills below the student's grade placement.
3. Errors at or near aim.

Leap-Up Phase
1. First day accuracy ration $\leq$ 1.1 (at least 10% more errors).
2. If the accuracy ratio is not met, take a larger leap.

Figure 2. Type Two Leap-Ups: Below Grade Level.

Variables Under Investigation

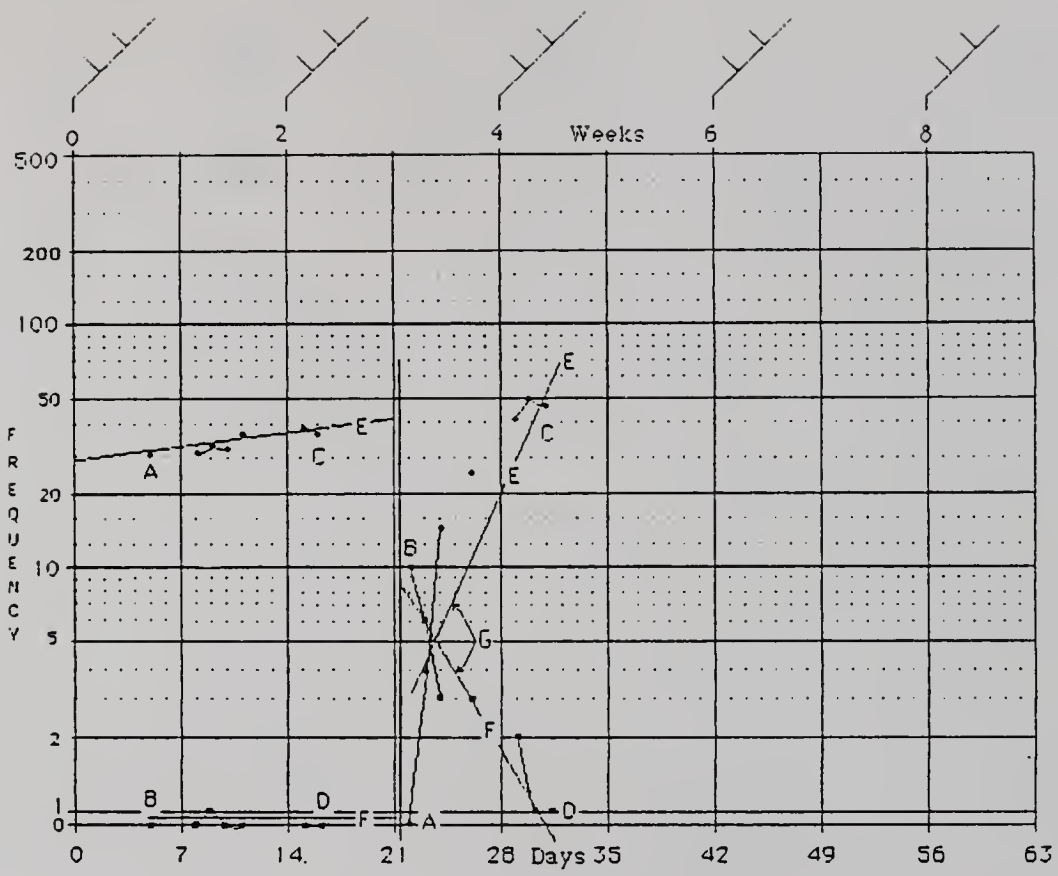
Dependent Variables

The four dependent variables in this investigation were celeration, improvement index, accuracy improvement, and fluency. All are measures of academic performance. Previous work indicates that celeration, accuracy, and fluency are sensitive dimensions (Koenig, 1972) likely to detect changes in the independent variable being manipulated. The improvement index was included because it is a convenient way of looking at the celeration for correct responses and errors at one time.

Figure 3 presents an example of each of the dependent variables. The figure illustrates both a preleap-up and leap-up phase. Figure 3 and the measures used in this investigation are explained fully under the measurement section of this chapter.

Independent Variable

The independent variable is a curriculum leap-up (See Figures 1 and 2). A curriculum leap-up is a change from a skill with an initially low error rate to a skill with an initially high error rate. The size of a leap-up depends on the individual subject, rather than on the skill. For some subjects a leap to the next level in a curriculum ladder met the error requirements; for others a much larger leap up the curriculum ladder was required in order for the error



Symbol	Name	Formula	Value Preleap-up	Value Leap-up
A	Initial Perf.	Frequency for Corr.	32	3
B	Initial Perf.	Frequency for Errors	0	8
C	Final Pref. (Fluency)	Frequency for Corr.	52	60
D	Final Perf. (Fluency)	Frequency for Errors	0	0
E	Cel for Corr. (Learning)	mov/min/week for Corr.	x1/15	x8.40
F	Cel for Err. (Learning)	mov/min/week for Err.	x1.0	/5.80
G	Improvement Index	cel for corr x cel for errors	x1.15	x50
H	Accuracy Impr.	Final accuracy ratio/ initial accuracy ratio	x1.12	x160

Figure 3. Examples of Dependent Variable Measures.

criteria to be met. Both Slow Growth and Below Grade level types of leap-ups, as mentioned under the subject section, were used.

Experimental Design

The experimental design in this study is single subject. Single subject designs make it feasible to demonstrate within subject control because the unit of analysis is the individual. Replications across subjects, teachers, skills, and settings were done to demonstrate the reliability and generality of the findings (Tawney & Gast, 1984).

This investigation presented a special design challenge. In educational settings, designs that require the repeated withdrawal or reversal of the independent variable may not be practical (Tawney & Gast, 1984). In these experiments, it is not meaningful to return to a baseline after a leap-up because the student is learning new material during the leap-up.

The designs used in this investigation do not completely fit any of the standard design descriptions. They do have elements in common with the AB, multiple baseline, and alternating treatment designs. The two designs used in this investigation meet the unique needs of the real world teaching situation (Alberto & Troutman, 1982; Haring, Lovitt, Eaton, & Hansen, 1978). They are referred to as Leap and Keep and Leap and Leave designs.

Leap and Keep Design

The Leap and Keep designs are illustrated in Figure 4. Every vertical line (change line) gives the opportunity to observe an experimental effect. Because the baseline A is continued when the treatment B is introduced, the design controls for maturation and correlated historical variables.

Leap and Leave Design

The Leap and Leave designs are illustrated in Figure 4. There is one opportunity (change line) with this design for an experimental effect to be observed. This design is most like the AB design.

The AB design provides a structure for drawing experimentally valid conclusions when certain conditions are met (Tawney & Gast, 1984). Optimal conditions include

(1) Behaviorally defined target behavior.

(2) Collection of continuous baseline data (at least 3 days).

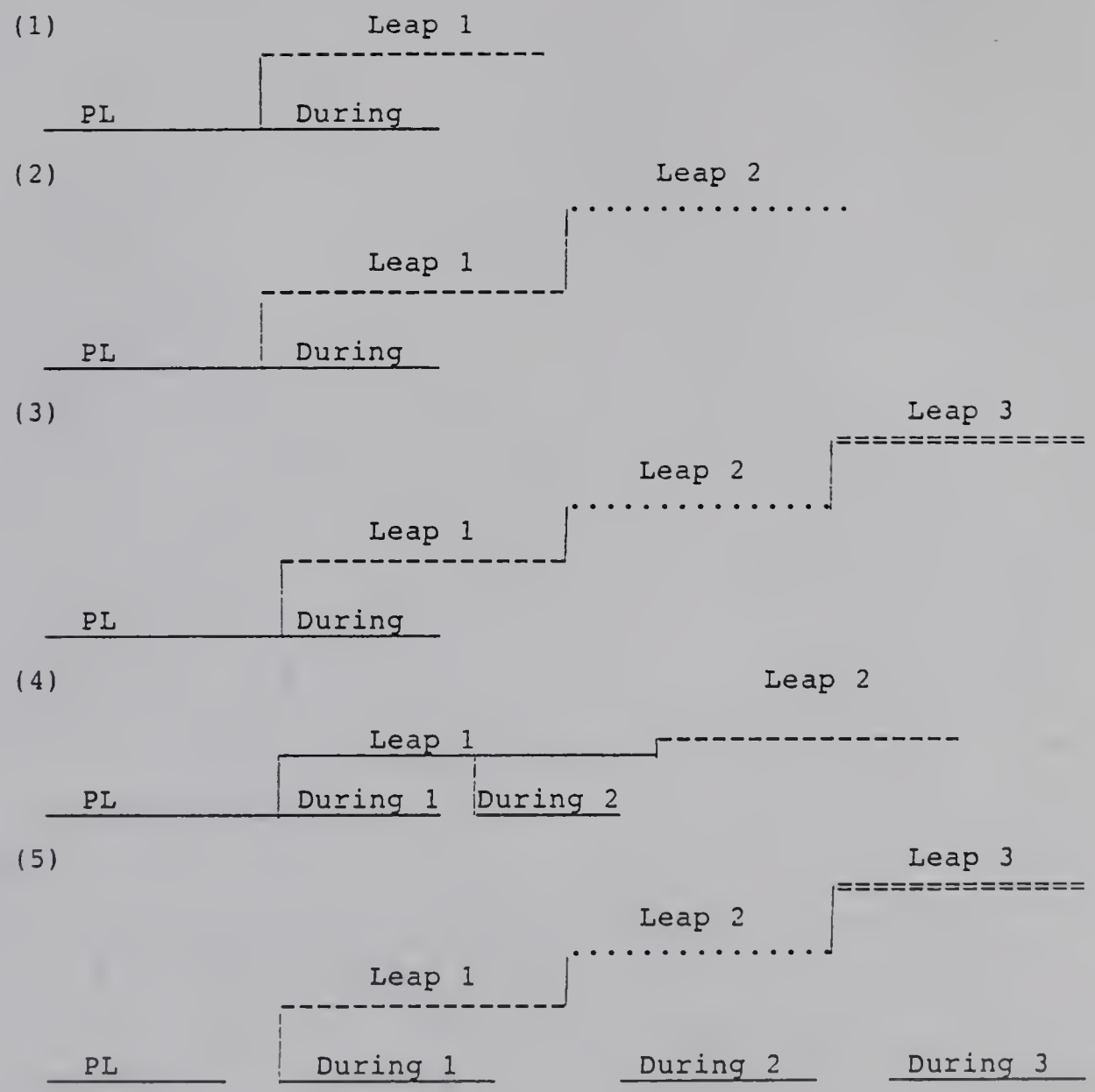
(3) Introduction of the independent variable only after the baseline trend is stabilized.

(4) Continuous collection of baseline data on the target behavior during the intervention.

(5) Replicate the experimental effects with similar subjects.

This design can provide a convincing demonstration that outcomes are not a function of other variables (time, maturation, experience, unobserved correlated events) when

Leap and Keep



Leap and Leave

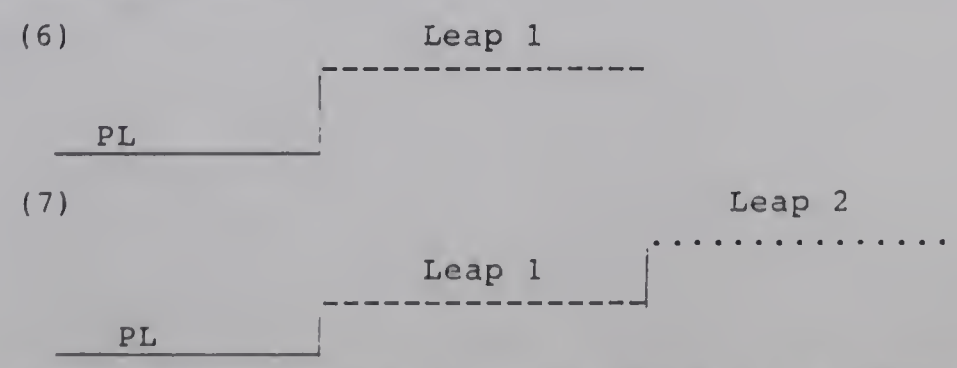


Figure 4. Diagrams of Experimental Arrangements.

behavioral changes measured following the intervention are immediate and abrupt following a stable baseline.

Conclusions drawn by AB designs may be limited by threats to internal validity and/or external validity. The lack of data on the natural course of the preleap-up behavior during the intervention phase or a novelty affect were concerns in this experiment. Therefore, several replications were done. Several replications of the experimental effect with this design are usually quite convincing. The design has certainly served very well in medicine over the past 150 years.

Procedure

Pre-experimental Phase

During this phase the practicum teachers received training in identifying students and skills for the leap-up strategy during their weekly practicum sessions. They were also trained in using the Decision and Outcome form and in using the quarter intersect method to draw learning lines. With the aid of the investigator pinpoints for possible leap-ups were selected. Techniques for teaching in high initial error environments were discussed.

Experimental Phase

During this phase the practicum teachers selected students to participate in the investigation according to

the criteria for the two types of leap-ups and gathered the daily data for inclusion in the investigation. The following procedure was used for Leap and Keep experiments.

1. Students whose learning met the criteria for a Slow Growth or Below Grade Level leap-up were chosen to participate in the investigation.
2. A stable baseline on the preleap-up phase was verified with the investigator.
3. A skill related to the preleap-up skill but higher in the curriculum sequence was chosen for the student. The skill had to meet the requirement of having initially 10% more errors than correct responses or another skill was tried.
4. Both the preleap-up skill and the leap-up skill were continued. Daily timings were taken and charted on both skills. The leap-up skills were continued until experimental results were seen or an aim was met.
5. In some instances one or more additional leap-up skills were also added, making within teacher, learner, and skill replication possible.

The procedure for the experimental phase for the Leap and Leave investigations was identical to the above procedure with one exception. In Step 4 the preleap-up skill was dropped when the leap-up skill was started with a student.

The Leap and Keep and Leap and Leave field experiments by the practicum students were monitored by the investigator both in the classroom and in weekly chart share sessions. At the end of the investigation the teachers discussed their teaching procedures and results on the leap-up skills with the investigator.

Materials

Curricular Materials

The curricular materials used were based on the students' current academic program. Resource rooms in Alachua County use county adopted materials for each grade level along with remedial materials. Materials currently used include the Ginn and SRA reading series and the Heath math program. Most teachers used adaptations of the materials for precision teachers available from the Alachua Learning and Resource Center.

Data Recording Form

The Decision and Outcome Form was used to record all the specifics of the program and the outcomes. The information on the Form was combined with the charted data to obtain a complete picture of the learning in each phase. See Appendix C for a copy of the form.

Standard Celeration Chart

The Standard Celeration Chart (Pennypacker, Koenig, & Lindsley, 1972) was used to display and analyze all the data from the investigation. Precision teachers have made an attempt to standardize graphic displays of data by using this chart.

Measurement

Frequency, movements per minute (Pennypacker, Koenig, & Lindsley, 1972) was chosen as the basic unit of measurement in this investigation. For many academic and social behaviors, frequency yields more informations than other standard educational measurements (Haring, Lovitt, Eaton, & Hasen, 1978). Frequency, when used to measure both correct responses and errors, gives a measure of both the accuracy and fluency of a student's performance. Fluency, the rate at which a student performs a skill, is often the discriminating factor between a student who is acquiring a skill and one who is proficient at a skill. Percent scores, most often used in educational settings, provide only a measure of the accuracy of a student's performance and give no indication of fluency. When using percent data there is no way to discriminate between the student who is just accurate and the student who is both accurate and proficient. For example, if one student completes 50 math facts (100 digits) correctly in 20 minutes with no errors he is accurate but not proficient. If another one completes 50 math facts

(100 digits) correctly in 1 minute he is both accurate and proficient.

Frequency multipliers (the ratio between two frequencies) were used to analyze the data from this study. A frequency multiplier can be visualized as the distance between two frequencies on the Standard Celeration Chart. There are two levels of frequency multipliers. The first level is a ratio comparison between two frequencies on the chart. The second level is a comparisons between two ratios. Both types were used in this study and are illustrated below.

Figure 3 presents the data from a sample preleap-up and leap-up phase. The name of the behavior being measured, the formula for calculating it, and the value of the behavior being measured are given. If a multiplication sign (x) precedes the value, it indicates that the frequency of the behavior was accelerating. If a division sign (/) precedes the value, it indicates that the frequency of the behavior was decelerating. In Figure 3 the initial frequencies for correct responses and errors and the value for each of the dependent measures in this study were calculated for both the preleap-up and leap-up phases. These values were then used as the basis for the ratio comparisons done in Table 3.

In Figure 3, A and B represent the initial frequency for the corrects and errors in the two phases. The initial frequency is the point where the learning lines (one for correct responses, one for errors) cross the first day line

Table 3

Examples of Frequency Multipliers
from Preleap-Postleap Comparisons

Measure	Value		Multiplier
	Preleap-Up	Leap-Up	
Celeration For Correct Responses	x1.15	x8.40	x7.30
Celeration For Errors	x1.00	/5.80	x5.80
Improvement Index	x1.15	x50	x43
Accuracy Improvement	x1.62	x160	x99
Final Performance For Correct Responses	52	60	x1.15
Final Performance For Errors	0	0	x1.00

in a phase. The letters C and D represent the final frequencies for correct responses and errors on the learning lines. The final frequency is also know as fluency.

The letters E and F mark the celerations for corrects and errors. The unit for celeration is movements per minute per week. It describes the rate at which frequencies change in a week. Celeration is also called learning.

The letter G represents the improvement index. The improvement index is a ratio between the celeration for the corrects and the celeration for the errors. The measure conveniently summarizes improvement in correct and error responding into one number. Graphically, it can be visualized as the size of the angle between the celeration for the corrects and celeration for the errors.

The letter H represents accuracy improvement. Accuracy improvement is calculated by determining the ratio of the corrects to the errors at the beginning of a phase, and then comparing that value to the ratio of the corrects to the errors at the end of a phase. It is a measure of change in accuracy over time.

Table 3 presents the values for the comparisons between the preleap-up and the leap-up phases in Figure 3. These ratios are always calculated by dividing the smaller frequency into the larger frequency. For example, in the comparison for celerations for corrects in Table 3 the frequency multiplier is a x7.30. This was calculated by dividing x8.40 (c for corrects for leap-up phase) by x1.15

(c for corrects for preleap-up phase). The x sign indicates that the rate of learning was in favor of the leap-up phase.

Within the field of precision teaching there are, unfortunately, two ways in which the multiply and divide sign are used. The signs may be used to identify movement on the chart: x for acceleration and / for deceleration. The sign may also be used to signify the direction of an experimental effect: x for an increase, and / for a decrease by the indicated factor.

For making comparisons in this investigation, the x sign before the frequency multiplier was used to indicate that the leap-up phase is better than the preleap-up phase on the comparison measure. The / sign was used to indicate that the leap-up phase worsened by the factor indicated on the comparison measure.

Date Recording and Analysis

Data Recording

Daily data were recorded on the Academic Behavior Chart-3 (Wolking, 1983) by the practicum teachers and their students. Each time a phase change was made the data for the completed phase was recorded on the Decision and Outcome sheets by the teachers and the forms were given to the investigator.

For purposes of analysis, the data from the preleap-up and leap-ups were plotted on the Standard Behavior Chart

using frequency for correct responses and errors. This allowed for visual analysis of the preleap-up and leap-up phases of learning. The scale on the Standard Behavior chart is a ratio scale. Most measurement in educational research occurs at the nominal, ordinal, and interval levels because it is difficult to find variables that lend themselves to ratio measurements (Glass & Stanley, 1970). Ratio scales are considered to be the most sensitive scales of measurement because they allow for interval comparison and for an absolute zero--which indicates the total absence of the movement being measured. Further, plots of human behavior frequencies, as they change over time, on a ratio scale, tend to be linear and thus permit relatively easy predictions (Pennypacker, 1974).

Data Analysis

Visual inspection of all the data and frequency multipliers were both used for data analysis. Frequency multipliers add quantification to the visual inspection procedure by making it easier to compare results across subjects, settings, skills, and teachers. No test of statistical significance exists for these ratios. Rather, they are evaluated in the context of expert judgment of their practical importance.

CHAPTER IV

RESULTS

The results for the two types of leap-ups, Leap and Keep and Leap and Leave, are presented separately. An example of a reading leap-up and a math leap-up are presented in detail for each type. Other cases are presented as replications within each type of experimental condition.

Leap and Keep

The results for the Leap and Keep experiments are presented in two tables. Table 4 is a summary of all the data on the Leap and Keeps. Leap and Keep leap-ups involve continuing the preleap-up phase after the introduction of a leap-up. Both skills are taught and measured daily. Eight subjects and five teachers in five settings were included in the Leap and Keep experiments. The subjects experienced sixteen leap-ups. Eight of the leap-ups were reading related and eight were on math skills.

The four dependent variables (celeration for correct responses and errors, improvement index, accuracy improvement, and fluency) were determined for each preleap-up, during, and leap-up phase. Preleap-up phases include all the data taken before a leap-up began. During phases

Table 4

Leap and Keep Design: Learning Outcomes by Subject, Teacher, and Skill

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
W.T.	J.R.	Below Grade Level		Alphabet	Preleap	9	x1.05	/1.52	x1.59	x2.3	20	0
				Alphabet	During	12	x1.18	/1.22	x1.44	x2.9	40	0
			1	Vocab Ginn Level 2	Leap-up	12	x1.51	/1.46	x2.20	x11.3	18	3.2
			2	Vocab Ginn Level 5	Leap-up	23	x1.3	/1.66	x2.15	x61.9	38	0
J.V.	S.L.	Below Grade Level		Phrases & Vocab Ginn Level 7	Preleap	6	x1.23	/1.82	x2.24	x5.14	90	0
					During	16	x1.20	/1.23	x1.48	x5.17	90	0
			1	Phrases & Vocab Ginn Level 8	Leap	11	x1.45	/1.45	x2.10	x8.1	80	2.5
				Ginn Level 7	During	7	x1.57	x1.0	x2.57	x2.63	100	3

Table 4

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
			2	Ginn Level 8	Leap	11	x1.86	/3.0	x5.58	x68	130	0
				Ginn Level 7	During	7	x1.46	/1.7	x2.48	x4.46	50	2
			3	Ginn Level 8	Leap	10	x2.4	/4.6	x11.04	x44	60	1.3
D.P.	C.F.	Below Grade Level		Ginn Vocab Level 8	Preleap	8	x1.45	/1.73	x2.50	x18	60	0
				Level 8	During	3	x1.05	/1.05	x1.10	x1.12	65	0
				Level 8	During	8	x1.55	/1.27	x1.97	x5.61	60	1.8
			1	Ginn Vocab Level 11	Leap-up	12	x1.35	x1.0	x1.35	x3.11	59	2.5
			2	Level 11	Leap-up	7	x1.65	/1.24	x2.05	x4.71	37	2
D.P.	C.F.	Below Grade Level		Ginn Phrases Level 8	Preleap	3	x6	/8.2	x49.2	x6	68	0

Table 4

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
				Level 8	During	3	x1.72	/10	/72	x2.41	88	0
				Ginn Phrases Level 11	Leap-up	8	x1.74	/1.9	x3.31	x11	113	0
N.R.	S.B.	Slow Growth		Sums to 18	Preleap	5	x1.25	/2.0	x2.5	x1.41	22	0
					During	10	x1.00	x1.0	x1.00	x1	36	0
			1	Rounding Nos.	Leap-up	11	x1.56	/1.66	x2.59	x9.8	49	0
			2	2 column/ 2 digit subtraction	Leap-up	5	x1.40	/22.5	x3150	x80	20	0
C.J.	S.B.	Slow Growth		Sums to 18	Preleap	10	x1.03	x1.0	x1.03	x1.06	48	0
					During	5	x1.14	x1.0	x1.14	x1.23	59	0
			1	Rounding Nos.	Leap-up	9	x2.16	/8.06	x17	x29	50	0

Table 4

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
			2	Addition 2 column/ 2 digit w/b	Leap-up	5	x1.80	/3.25	x5.83	x32	23	0
			3	Subtraction 2 col/ digit w/b	Leap-up	4	x3.5	/25	x86	x56	28	0
A.K.	J.R.	Slow Growth		Sums to 10	Preleap	6	x1.06	x1.0	x1.06	x1.36	15	0
					During	8	x1.19	x1.0	x1.19	x1.16	14	8
				Addition 2 digit w/c	Leap-up	4	x1.95	/2.6	x5.07	x6.6	5	1.5
Y.B.	B.M.	Slow Growth		Mult. Facts	Preleap	4	x1.60	/1.05	x1.68	x1.65	52	0
					During	4	x1.24	x1.0	x1.24	x1.11	59	0
			1	One place division	Leap-up	15	x1.42	/4.2	x5.96	x195	39	0

Table 4

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
G.R.	B.M.	Slow Growth		Mult. Facts	Preleap	3	x1.55	x1.00	x1.55	x1.42	61	0
					During	6	x1.40	x1.00	x1.40	x1.38	90	0
			1	Square Root	Leap-up	19	x1.75	/3.50	x4.55	937	95	0

include all the data from the continuation of the preleap-up skill after the introduction of the leap-up skill, and leap-up phases include all the data from the leap-up skill. The number of data points in each phase and whether the leap-up was a Slow Growth or Below Grade Level leap-up are also reported in Table 4.

Following is a brief explanation of how to read the results presented in Table 5. Table 5 presents comparisons between the celerations, improvement index, accuracy improvement, and fluency for the preleap-up, during, and leap-up phases. The comparisons were done using frequency multipliers. If the change represents an improvement, the value is assigned a multiplication sign (x). If it represents a worsening situation, the value is assigned a division sign (/).

By subtracting 1 from the frequency multiplier, and moving the decimal point 2 places to the right, comparisons between the phases can be discussed as percentages. Looking at the first leap-up in Table 5, for subject W.T., the frequency multiplier for the celerations for the correct responses between the preleap-up and the first leap-up phase is a x1.24. This means that the correct responses accelerated 24% faster in the leap-up phase than in the preleap-up phase. For the error celeration the frequency multiplier is /1.04. This means that the errors decelerated 4% slower in the leap-up phase than in the preleap-up phase. For the improvement index the frequency multiplier indicates that

Table 5

Leap and Keep Design: Frequency Multipliers for All the Preleap-Postleap-Up Comparisons

Subject	Condition	Skill	Celeration C	Celeration E	Imp Index	ACC Imp	Fluency C	Fluency E
WT	Preleap-Up Leap-Up 1	Alphabet Ginn L2	x1.24	/1.04	x1.38	x4.91	/1.10	/1.06
	During Leap-Up 1	Alphabet Ginn L2	x1.10	x1.19	x1.52	x3.89	/2.2	/3.2
	Preleap-Up Leap 2	Alphabet Ginn L5	x1.44	x1.09	x1.35	x26.9	x1.90	x3
JV	Preleap-Up Leap-Up 1	Ginn L7 Ginn L8	x1.18	/1.25	/1.06	x1.58	/1.30	/2.3
	During Leap-Up	Ginn L7 Ginn L8	x1.20	x1.18	x1.42	x1.56	/1.13	/2.3
	Preleap-Up Leap-Up 2	Ginn L7 Ginn L8	x1.51	x1.65	x2.49	x13	x1.44	x1
	During Leap-Up 2	Ginn L7 Ginn L8	x1.18	x3	x2.17	x26	x1.30	x3
	Preleap-Up Leap-Up 3	Ginn L7 Ginn L8	x1.95	x2.53	x4.93	x10	/1.50	/1.30
DP	Preleap-Up Leap-Up 1	Ginn Phr. L11 Ginn Phr. L11	/3.45	/4.31	/15	x1.78	x1.66	x1
	During Leap-Up 1	Ginn Phr. L8 Ginn Phr. L11	x1.01	/5.26	/5.10	x4.43	x1.28	x1
DP	Preleap-Up Leap-Up 1	Ginn V L8 Ginn V L11	x1.07	/1.73	/1.85	/5.61	x1	/2.5

Table 5

Continued

Subject	Condition	Skill	Celeration C	Celeration E	Imp Index	ACC Imp	Fluency C	Fluency E
	During 1	Ginn V L8	x1.29	x1.29	x1.23	/2.50	/1	/2.5
	Leap-Up 1	Ginn V L11						
	During 2	Ginn V L8	/1.5	/1.27	/1.46	/1.18	x1	x1.39
	Leap-Up 1	Ginn V L11						
	Preleap-Up	Ginn V L8	x1/14	/1.40	/1.21	/3.73	/1.62	/2
	Leap-Up 2	Ginn V L11						
NR	Preleap-Up	Sums to 18	x1.95	/1.20	/2.34	/6.95	x2.22	x1
	Leap-Up 1	Rounding Nos.						
	During	Sums to 18	x1.56	x1.66	x2.59	x9.8	x1.36	x1
	Leap-Up 1	Rounding Nos.						
	Preleap-Up	Sums to 18	x175	x11	x1969	x57	x11.1	x1
	Leap-Up 2	2 digit sub						
A.K	Preleap-Up	Sums to 10	x1.84	x1.50	x2.60	x4.78	/3	/1.50
	Leap-Up 1	2 digit Add w/c						
	During	Sums to 10	x1.64	x1.50	x2.60	4.26	/2.8	/1.50
	Leap-Up 1	2 digit Add w/c						
C.J.	Preleap-Up	Sums to 18	x2.09	x8.06	x17	x27	x1/04	x1
	Leap-Up 1	Rounding Nos.						
	During	Sums to 18	x1.89	x8.06	x15	x24	/1.18	x1
	Leap-Up 1	Rounding Nos.						
	Preleap-Up	Sums to 18	x1.75	x3.25	x5.67	x30	/2.08	x1
	Leap-Up 2	2 digit Add w/c						
	Preleap-Up	Sums to 18	x3.40	x25	x83	x53	/1.71	x1
	Leap-Up 3	2 digit Sub w/b						

Table 5

Continued

Subject	Condition	Skill	Celeration C	Celeration E	Imp Index	ACC Imp	Fluency C	Fluency E
YB	Preleap-Up	Mult. Facts	/1.13	x4	x3.55	x58	/1.33	x1
	Leap-Up 1	1 place div.						
	During	Mult. Facts	/1.15	x2.40	x4.58	x86	x1.51	x1
	Leap-Up 1	1 place div.						
GR	Preleap-Up	Mult. Facts	x1.13	x3.50	x2.94	x660	x1.56	x1
	Leap-Up 1	Square Root						
	During	Mult. Facts	x1.25	3.50	x3.25	x679	x1.05	x1
	Leap-Up 1	Square Root						

the leap-up phase was improving 38% faster, while accuracy improvement was 391% better for the leap-up phase. Fluency was 10% better for the correct responses and 6% better for the errors in the preleap-up phase, compared with the leap-up phase.

Reading Experiment: J.V. Ginn Phrases

J.V. was a 5th grade student classified as emotionally disturbed. He was working on Ginn level 7 phrases and vocabulary. The teacher decided to leap J.V. up to a higher level of Ginn (see Figure 5) because he was working below his grade level placement and had expressed an interest in doing "harder work." His preleap-up celeration for correct responses indicated that he was progressing at 23% per week, while his errors were going down at 82% per week (see Table 4). For J.V. a leap-up to Ginn Level 8 produced the required error rate of 10% more errors than correct responses.

Table 5 shows the comparison between the preleap-up phase for J.V. on Level 7 Ginn and three separate leap-ups to Level 8 Ginn. The celeration for the correct responses was 18% faster for the first leap-up, 51% faster for the second leap-up, and 95% faster for the third leap-up when compared to the preleap-up phase. For error deceleration, the effect of the leap-up teaching strategy grows as the teacher learns to teach to errors. In the first leap-up, the error celeration was 25% faster during the preleap-up

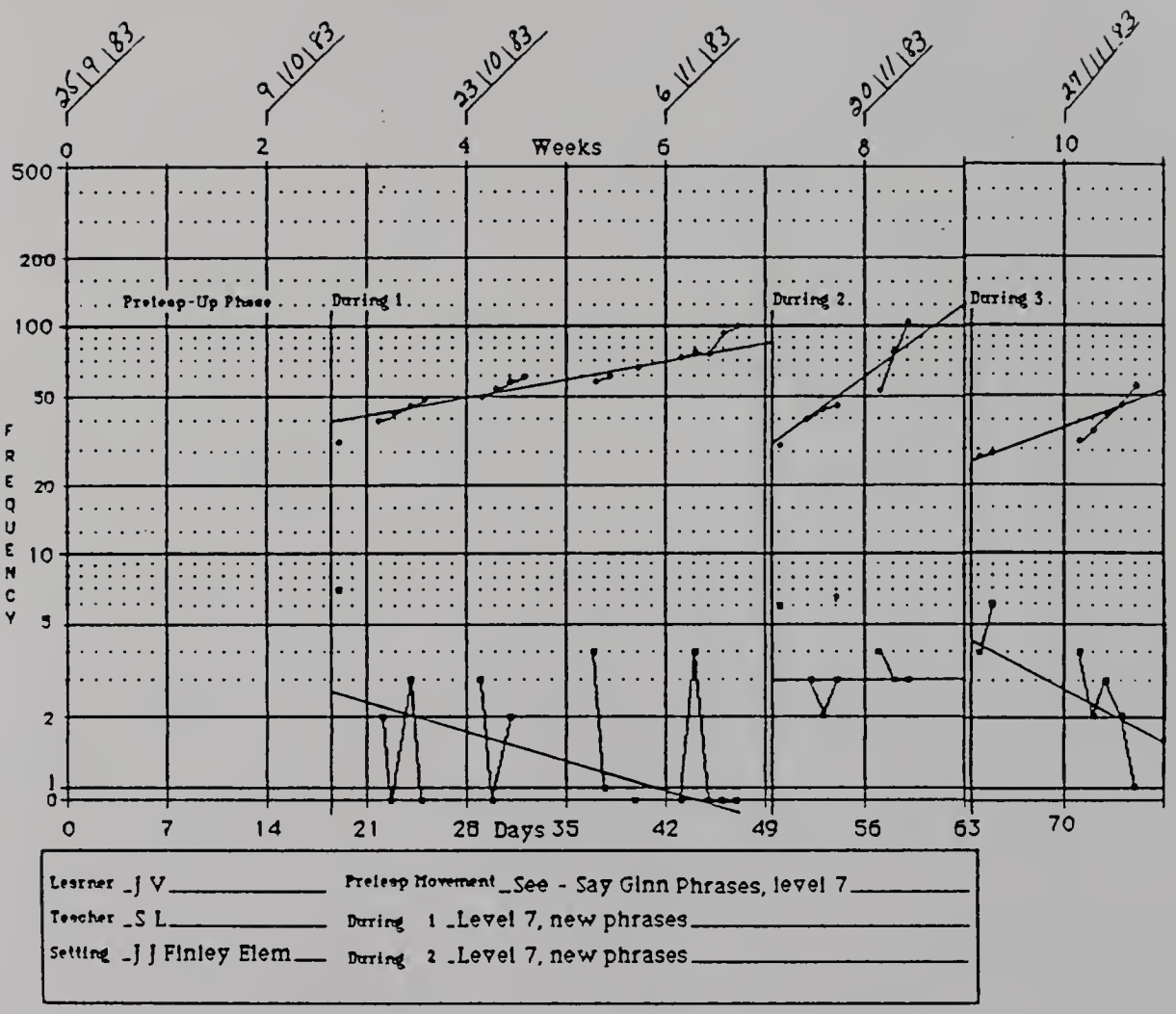


Figure 5. The Reading Leap and Keep Example.

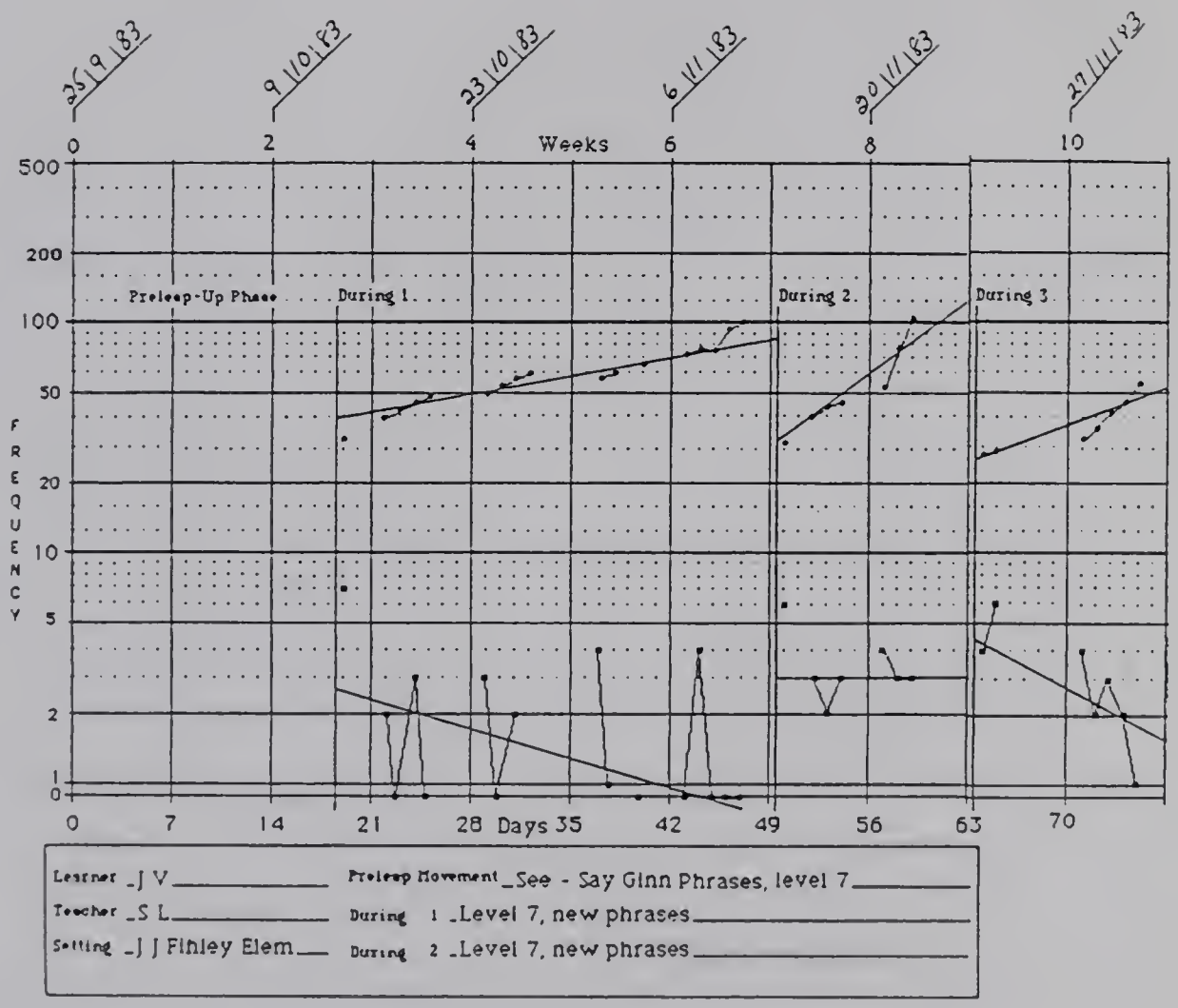


Figure 5. Continued.

phase. During the second leap-up it was 65% faster for the leap-up phase, and for the third leap-up, it was 153% faster for the leap-up phase.

The improvement index was almost equal for the first leap-up, but much faster for the leap-up phases in leaps two and three. The improvement index for the first leap-up was 6% faster for the preleap-up phase, the second was 149% faster for the leap-up phase, and the third was 393% faster for the leap-up phase. Accuracy improvement across the three leap-up phases was much better for the leap-up phases than for the preleap-up phase ranging from 58% to 1300% better. J.V. obtained better fluency in the preleap-up phase for two of the three leap-ups.

When comparing the 3 leap-ups to the during phases the findings for celeration, improvement index, and accuracy ratio were similar to the preleap-up comparisons. The leap-up phases provided faster celerations, more improvement, and higher accuracy improvement. Fluency was better in the during phase for the first leap-up, but better in the leap-up phases for the second and third leap-ups.

Systematic Replications on Other Reading Leap-Ups

Similar results were found for subject W.T., a first grade EMR student in a resource room. This subject experienced two leap-ups (see Table 4). The preleap-up phase was learning to say the alphabet and the two leap-ups were to

Ginn Level 2 and then Ginn Level 5 vocabulary. Her beginning celerations for the preleap-up phase indicated slow growth for correct responses and a fairly good deceleration of errors (see Table 4). Results were similar to J.V.'s results. Here celerations for correct responses were steeper in both leap-up phases. Error deceleration was almost equal for the comparison between the first preleap-up and leap-up phases and 9% faster for the leap-up phase during the second leap-up.

The improvement index was faster and accuracy improvement was higher for both leap-ups. Fluency was better during the preleap-up phase when compared with the first leap-up, but better in the leap-up phase for the second.

For D.P., a 5th grade learning disabled student working on Ginn vocabulary and phrases, mixed results were obtained. But the findings were generally in favor of the preleap-up phases. D.P. was given two grade level leap-ups from Ginn Level 8 to Ginn Level 11 vocabulary. His rate of learning was already quite high on his preleap-up phase (see Table 4). For the two leap-ups, celeration for correct responses was 7% in favor of the preleap-up phase for the first leap-up and 14% in favor of the preleap-up phase during the second leap-up. Error deceleration was faster for the preleap-up phases. It was 73% faster for the first leap-up and 40% faster for the second-leap-up in favor of the preleap phases. The improvement index and accuracy

improvement measures were also better for the preleap-up phase.

On the reading phrases the preleap-up rate of learning was also greater. In D.P.'s case his preleap-up condition was unique in that his correct and error celerations were both very high before the leap-up. Although these results favor the preleap condition, it is important to note that D.P. continues to learn very well on the Level 11 Ginn phrases, an increase in three levels over the preleap material.

Systematic Replications with Math Leap-ups

The comparisons for N.R., an educably mentally retarded student, were similar to J.V.'s results (see Table 5). In his first leap-up all the measures for rate of learning were better for the leap-up phase except error deceleration which was 20% in favor of the preleap-up phase. In his second leap-up all the measures for learning increased dramatically in favor of the leap-up phase including error deceleration. Results show that acceleration for corrects was better by a factor of 175, error deceleration was better by a factor of 11, the improvement index was 1960 times better, and accuracy improvement was 57 times better during the leap-up phase. Fluency was better in the preleap-up phase for the first leap-up, and for the leap-up phase for the second leap-up.

A.K., an emotionally handicapped student, C.J., an educably mentally retarded student, and G.R. and Y.B., learning disabled students, were given a total of six math leap-ups. They all showed an increase in learning following the leap-up condition for celeration, growth, and accuracy improvement (see Table 5). Results show that celerations for increasing correct responses and decreasing errors were higher, improvement was faster, and accuracy improvement was higher. Fluency was better for two of the leap-ups when compared with the preleap condition and for two of the leap-ups when compared with the during conditions.

Math Example: Add Facts/Rounding Numbers

C.J., a middle school educably mentally retarded student, was given a leap-up from add facts to rounding numbers (see Figure 6). C.J. had been working on add facts in order to build up her fluency in adding number facts. Her celeration for corrects was a x1.03 and for errors a x1.0. It was decided to leap-up because her progress was slow and she was bored practicing the facts.

A comparison of the celerations for the two phases (see Table 5) for her first leap-up show that the leap-up condition produced faster celeration for the corrects by a factor of 2 and errors were reduced faster by a factor of 8. The improvement index and accuracy improvement were improved by factors of 17 and 27 respectively. Fluency was 4% better

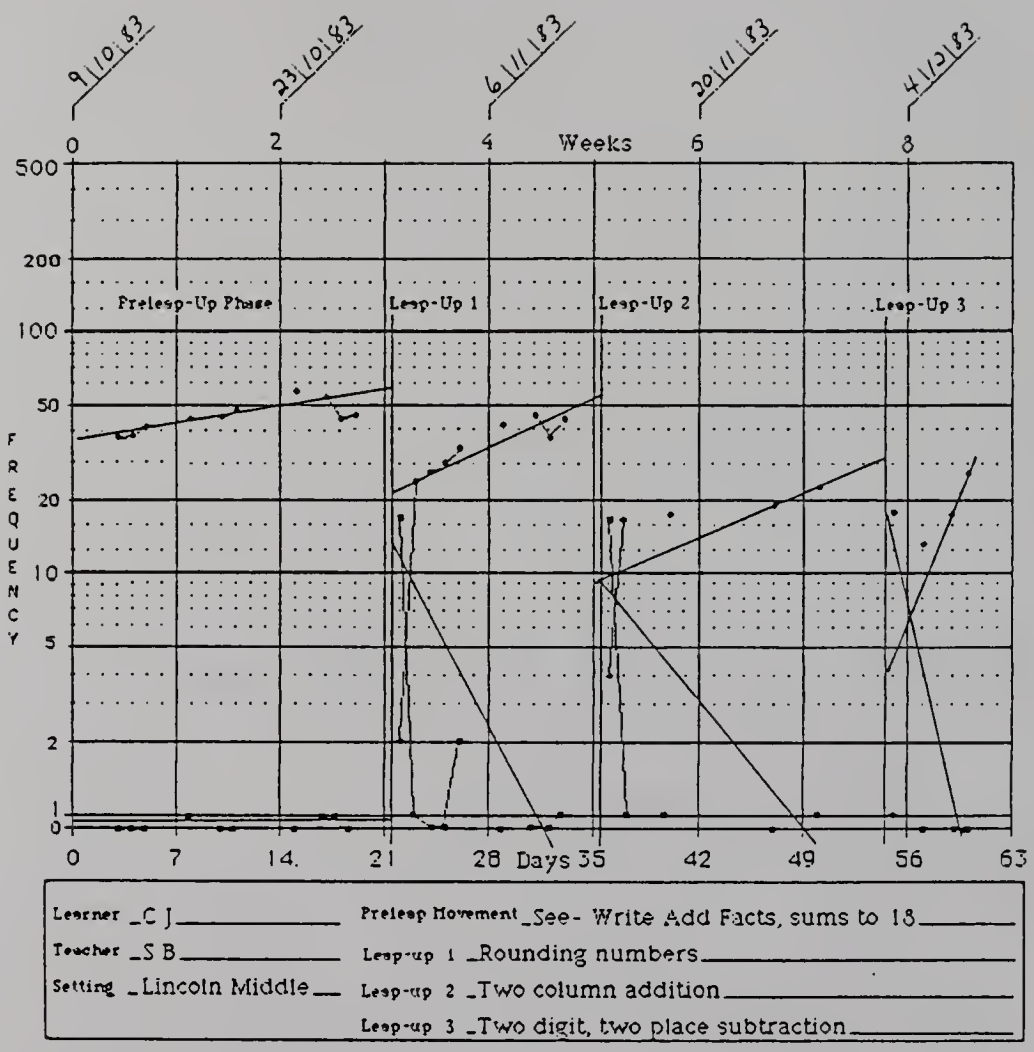


Figure 6. The Math Leap and Keep Example.

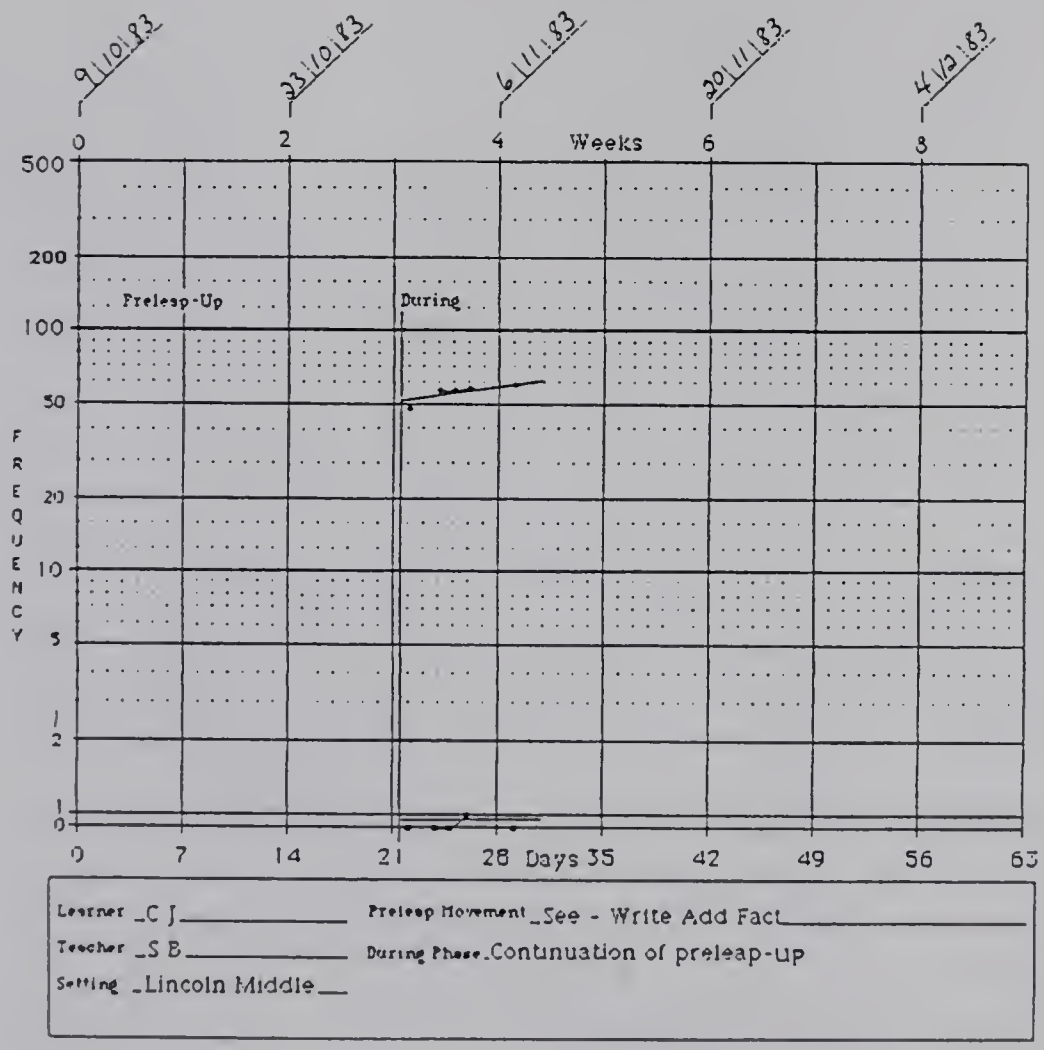


Figure 6. Continued.

for the leap-up phase. Results from the during phase comparison were very similar.

Two more leap-ups were then done with C.J. in order to replicate the experimental effects within subject. They were two place addition with carrying and two place subtraction with borrowing. Both leap-ups showed an increased rate of learning as measured by celeration, improvement index and accuracy improvement similar to the first leap-up. Both leap-up phases were short. Fluency was higher for corrects during the preleap-up condition and was the same for errors across both conditions.

Replications With the Same Math Skills

Two of the leap-ups from C.S. were replicated with another student, N.R., an EMR student was given a leap-up from add facts to rounding numbers. Results were similar to C.J.'s. Her comparisons for celeration for correct responses, improvement index, and accuracy improvement, and fluency were all higher in the leap-up phase when compared with the preleap-up or during phase. Her second leap-up to subtraction with borrowing also resulted in higher rates of learning on all the measures including error deceleration. Celeration, improvement index, and accuracy improvement were all better in the leap-up phase while fluency was better in the preleap-up phase. Her error decelerations were not as high as C.J.'s.

Systematic Replications with Other Math Skills

Three other leap-ups were done with students on math skills. The first one was a leap-up for A.K., an elementary emotionally handicapped student. The leap was from add facts to 2-digit adding with carrying. His celeration, improvement index and accuracy improvement increased during the leap-up phase but his fluency level was lower. G.R., an emotionally handicapped student, was given a leap-up from multiplication facts to square roots. His learning on the leap-up skill was faster on all measures including fluency. Another student, Y.B., was given a leap-up from multiplication facts to one place division. Her learning rates were better on all measures except celeration for correct responses. Fluency was better in the preleap-up phase.

During Phases

The Leap and Keep Design controls for maturation and correlated historical events by continuing the preleap-up phase when the leap-up begins. The results from these experiments indicate that learning rates were faster as measured by celeration for correct responses and errors, improvement index, and accuracy improvement during the leap-up phases compared with the during phases. These results were replicated 9 times across subjects, skills, teachers, and settings. Fluency for correct responses was generally in favor of the during phases compared with the leap-up phases, and fluency for errors was mixed, some of

the leap-up phases achieving higher fluency and some of the during phases achieving better results for errors. These results indicate that maturation and outside events were not responsible for the higher rate of learning during the leap-up condition.

Summary of Leap and Keeps

A total of 16 Leap and Keep Leap-ups were done with 8 students. Nineteen of twenty-eight comparisons across all the preleap-up, during, and leap-up phases showed an increase in student rate of learning as measured by celeration, improvement index, and accuracy improvement in the leap-up phase. Three of the comparisons indicated better error deceleration for the preleap-up phases, which was subsequently followed by additional leap-ups with the same students in which the errors decelerated more rapidly in the leap-up phases. For one comparison, the celeration for correct responses was better for the preleap-up phase, but all other measures were better for the leap-up phases.

Five comparisons were in favor of the preleap-up phases on rate of learning comparisons. These were all reading leap-ups in which the student began with high initial acceleration for correct responses and deceleration for errors. The results for the fluency measure were mixed with some of the preleap-up and during phases achieving a higher terminal frequency than the leap-up phases.

The findings that the leap-up teaching strategy produces a higher rate of learning as measured by celeration for correct responses and errors, improvement index, and accuracy improvement was replicated across 3 teachers, 3 settings, 6 students, and 9 skills using the Leap and Keep Design. Possible factors involved in replication failures will be discussed in the next chapter.

Leap and Leave

Table 6 presents a summary of all the data on the Leap and Leave experiments. Leap and Leave leap-ups use the procedure of dropping the skill with low error rate when the leap-up skill starts. Nine subjects and five teachers in five settings were included in the Leap and Leave experiments. The subjects experienced 13 leap-ups. Two of the leap-ups were on reading skills and the other eleven were math skills. The five dependent measures are presented for each preleap-up and leap-up phase. The number of data points in the phase and whether the leap-up is a Slow Growth or Below Grade Level leap-up are also given.

Table 7 presents the comparisons between the celerations, improvement index, accuracy improvement, and fluency for the preleap-up and leap-up phases. The comparisons were done using frequency multipliers, as in Table 5.

Table 6

Leap and Leave Design: Learning Outcomes by Subject, Teacher, and Skill

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
E.B.	M.G.	Below Grade Level		Oral Reading G1	Preleap	5	x1.42	x1.00	x1.42	x1.20	110	0
			1	Oral Reading CL	Leap-up	5	x24	/11	x264	x5.33	80	0
E.B.	M.G.	Below Grade Level		Vocabulary 2.2	Preleap	7	x1.37	x1.0	x1.37	x1.30	103	0
			1	Vocabulary 8.0	Leap-up	7	x1.83	/3.4	x25	x25	70	0
L.A.	W.O.	Slow Growth		Sums to 18	Preleap	8	x1.15	/1.05	x1.2	x1.30	63	0
			1	Mult. Fract. x2 x3	Leap-up	4	x11.7	/4.4	x51	x2.80	9	0
			2	Mult Fract. x4-x9	Leap-up	5	x3.90	/6.5	x2.5	x12	22	0
			3	Changing Dec. to %	Leap-up	5	x16.5	/17	x276	x32	8	0

Table 6

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
W.T.	J.R.	Below Grade Level		Sums to 6	Preleap	4	x1.39	/1.46	x1.90	x2.1	28	0
			1	2 digit Add w/c	Leap-up	7	x18.5	/8.0	x148	x140	35	0
R.J.	S.B.	Slow Growth		Sums to 18	Preleap	15	x1.13	x1.00	x1.13	x1.80	90	0
			1	Rounding off nos.	Leap-up	9	x1.75	/2.40	x4.2	x1.20	100	0
O.S.	B.M.	Slow Growth		Sums to 18	Preleap	8	x1.09	x1.00	x1.09	x1.15	54	0
			1	One place division	Leap-up	10	x1.46	/5.90	x8.61	x1.54	18	0
J.R.	B.M.	Below Grade Level		Sums to 10	Preleap	9	x1.20	/1.50	x2.4	x3.1	32	0
			1	Telling Time by 1/2 hour	Leap-up	7	x1.90	/2.59	x4.92	x10	14	0

Table 6

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
A.F.	W.O.	Below Grade Level		Sub Facts	Preleap	12	x1.30	x1.00	x1.30	x2.03	55	0
			1	Mult. of Fractions	Leap-up	3	x4.00	/9.6	x38	x10	5	1
R.V.	B.M.	Below Grade Level		Mixed Facts	Preleap	9	x1.27	x1.00	x1.27	x1.55	45	0
			1	Division of Fractions	Leap-up	4	x13	/583	x781	x26	36	0

Table 6

Continued

Subject	Teacher	Type	Leap #	Skill	Condition	# of Data Points	CC	CE	Imp Ind	Acc Imp	FL/C	FL/E
C.B.	B.M.	Slow Growth		Mult. Facts	Preleap	13	x1.15	x1.0	x1.15	x1.6	16	0
			1	2 place sub w/b	Leap-up	11	x1.5	/1.5	x2.25	x6.7	12	0
			2	Square Root	Leap-up	10	x2.03	/6.4	x13	x1320	22	0

Table 7

Leap and Leave Design: Frequency Multipliers for All Preleap-Postleap-Up Comparisons

Subject	Condition	Skill	Celeration C	Celeration E	Imp Index	ACC Imp	Fluency C	Fluency E
EB	Preleap-Up	Oral Reading G1	x17	x11	x186	x4.44	/1.38	/2.0
	Leap-Up	Oral Reading 12.0						
EB	Preleap-Up	Vocabulary 2.2						
	Leap-Up	Vocabulary 8.0	x1.34	x13	x18	x19	/1.47	x1
L.A	Preleap-Up	Sums to 18						
	Leap-Up	Mult. Frac. x2-x3	x10	x4.19	x43	x2.15	/7	x1
	Preleap-Up	Sums to 18						
	Leap-Up	Mult. Frac. x4-x9	x3.39	x6.19	x20	x9.23	/2.86	x1
	Preleap-Up	Sums to 18						
		Changing dec. to %	x14	x16	x125	x24	/7.88	x1
W.T.	Preleap-Up	Sums to 6						
	Leap	2 digit Add w/c	x13	x5.48	x78	x67	x1.25	x1
R.J.	Preleap-Up	Sums to 18						
		Rounding of 10/100	x1.55	x2.4	x3.72	x6.67	x1.11	x1
O.S.	Preleap-Up	Sums to 18						
	Leap-Up	One place division	x1.34	x5.9	x7.89	x134	/3	x1
J.R.	Preleap-Up	Sums to 10						
	Leap-Up	Telling time						
		by 1/2 hour.	x1.58	x1.73	x2.05	x3.23	/2.29	x1

Table 7

Continued

Subject	Condition	Skill	Celeration C	Celeration E	Imp Index	ACC Imp	Fluency C	Fluency E
A.F.	Preleap-Up	Subtraction Facts						
	Leap-Up	Mult. of Frac.	x3.07	x9.60	x29.2	x4.35	/11	x1
R.V.	Preleap-Up	Mixed Facts						
	Leap-Up	Div. of Fractions	x10.55	x58.3	x615	x17	/1.25	x1
C.B.	Preleap-Up	Mult. Facts						
	Leap-Up	2 place Sub w/b	x1.30	x1.5	x1.96	x4.19	/1.5	x1
	Preleap-Up	Mult. Facts						
	Leap-Up	Square Root	x177	x6.4	x11	x825	x1.61	x1

Reading Example: Oral Reading

E.B., an elementary school language disabled student, was given a leap-up from a first grade reading book to a college level astronomy text (see Figure 7). Several leaps to lower level reading material were tried but the error rate criteria could only be reached at this level. The preleap-up phase had a correct celeration of x1.42 and an error celeration of x1.00.

A comparison of the celerations for the two phases (see Table 7) shows that the leap-up condition was better by a factor of 17 for the correct responses and a factor of 11 for the errors. The improvement index was better by a factor of 186 and accuracy improvement was better by a factor of more than 4. Fluency was 38% better for the preleap-up phase for correct responses and it doubled for the errors. E.B.'s second leap-up on reading vocabulary produced similar results.

Systematic Replications with Math Skills

Eleven math replications of leap and leaves replicated the findings of E.B.'s leap-up. Three leap-ups in math were done for L.A., a middle school learning disabled student. The three leap-ups had faster celeration for correct responses by factors of 10, 3.3, and 14 and for errors by 4.19, 6.19, and 16. The improvement index for the three leap-ups ranged from a factor of 20 to a factor of 125 better. Accuracy improvement ranged from a factor of a

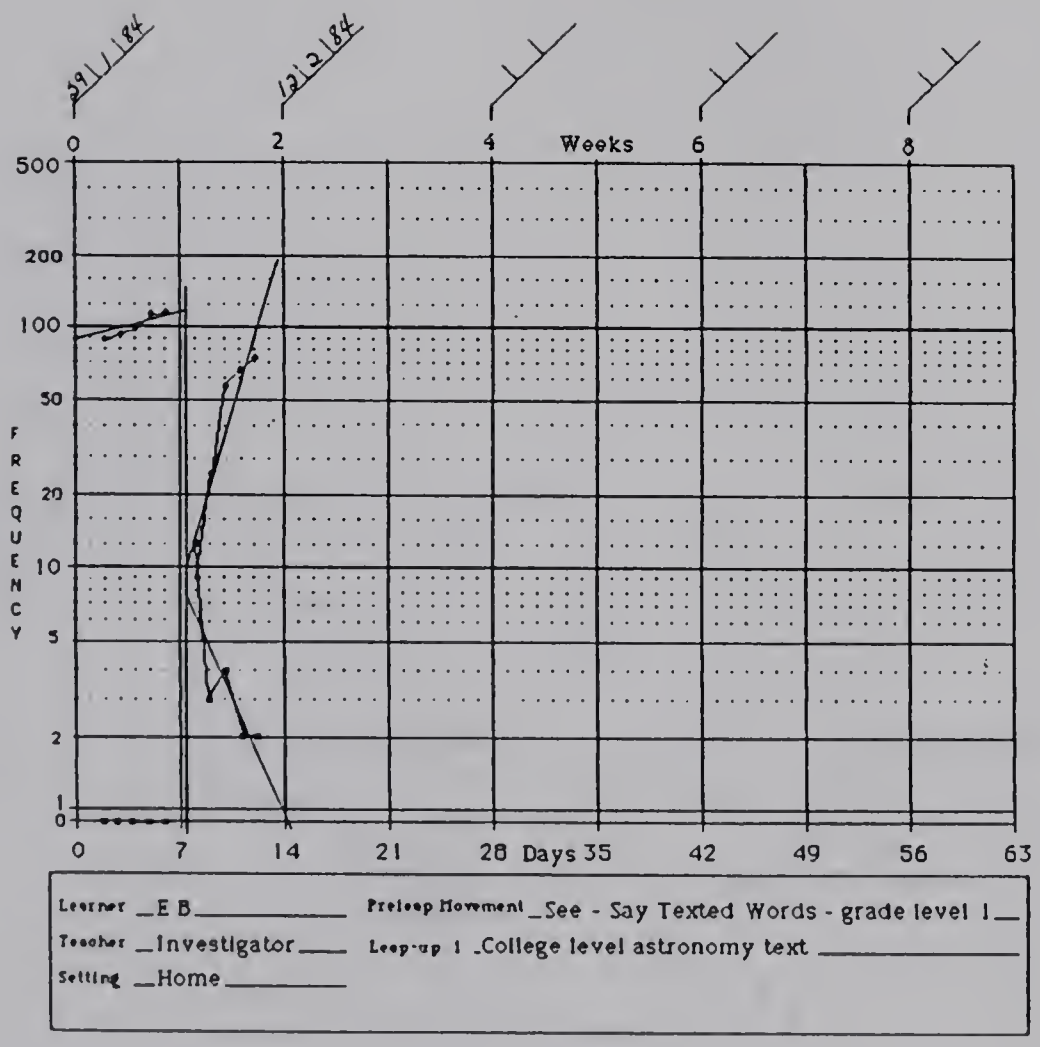


Figure 7. The Reading Leap and Leave Example.

little more than 2 to a factor of 24 better. Fluency was better in the preleap-up phases.

Four other leap-ups with middle school students R.V., A.F., O.S., and R.J. had similar results. Although the celerations for the correct responses were not as fast as E.B.'s leap-up, the other measures were comparable. Further, students who experienced two math leap-ups had faster learning as measured by celeration, improvement index, and accuracy improvement and also had higher fluency in their leap-up phases compared with their preleap-up phases.

Math Example: Add Facts/2 Digit Addition with Carrying

W.T., a mentally retarded student, was given a leap-up from learning add facts to 6 to doing two place addition with carrying (see Figure 8). Her preleap-up phase had a correct celeration at x1.39 and error celeration at x1.46. She was not achieving fluency on the addition facts even though her errors were going down.

A comparison of the celerations for the two phases (see Table 7) shows that the leap-up phase produced faster celeration for the corrects by a factor of 13 and that the error-learning improved by a factor of 5.4. The improvement index was better by x78, while accuracy improvement was better by a factor of 67 in the leap-up phase. Fluency was also higher in the leap-up phase.

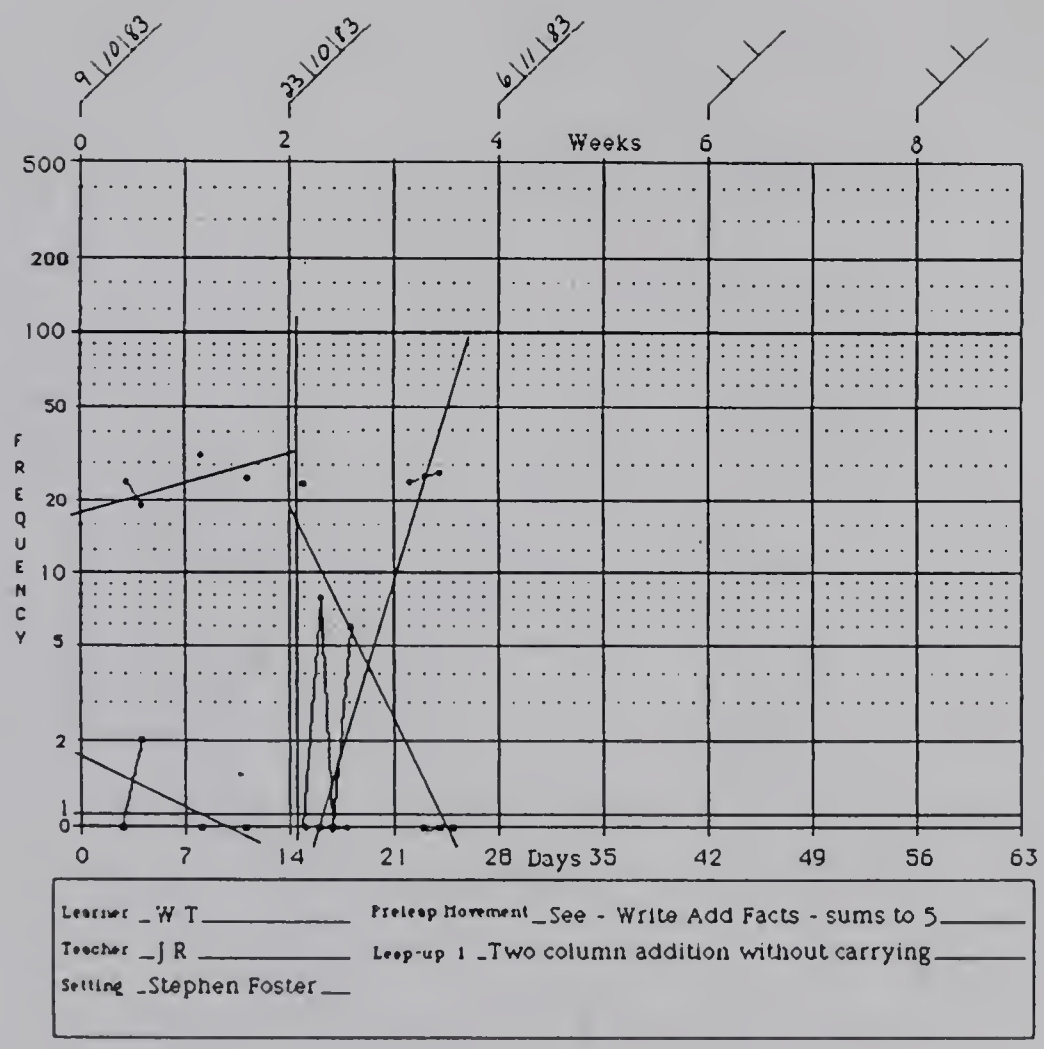


Figure 8. The Math Leap and Leave Example.

Systematic Replications With Other Math Skills

One math leap-up replicated the findings on all the measures of W.T.'s leap-up. Comparisons for R.J.'s leap-up (see Table 7) show that the celeration for the correct responses was 55% faster and improved error learning by a factor of 2.4 during the leap-up phase. The improvement index was better by x3.7 and accuracy improvement was better by a factor of 6.6. Fluency for correct responses was 11% better for the leap-up phase than for the preleap-up phase.

Nine math leap-ups replicated the findings of W.T.'s leap-up on all the measures except fluency. A comparison of the celerations for the correct responses shows that the leap-up phases produced better learning by factors between 1.3 and 16.8. Errors learning improved by factors between 1.5 and 58.3. The improvement index was better by factors between 1.9 and 615. Accuracy improvement changed by factors between 2.1 and 1659. Fluency was better in the preleap-up phases. The range for fluency was between x1.3 and x11 in favor of the preleap-up phases.

Summary of Leap and Leave Leap-Ups

A total of 13 Leap and Leave leap-ups were done with 8 students. Across all the preleap-ups and leap-up phases results show an increase in student rate of learning as measured by celeration, improvement index, and accuracy improvement. Three of the leap-ups resulted in higher fluency for the leap-up phase compared with the preleap-up

phase, while the remaining 10 leap-ups produced higher fluency during the preleap-up phases.

The findings that the leap-up teaching strategy produces a higher rate of learning as measured by celeration for correct responses and errors, improvement index, and accuracy improvement were replicated across 4 teachers, 4 settings, 8 students, and 12 skills using the Leap and Leave Design.

CHAPTER V

DISCUSSION

The discussion is organized around the experimental question, replications and previous knowledge, practical implications for special education and regular education, problems and limitations of the study, and recommendations for future research.

Experimental Question

Leap and Keep Design

Celeration, improvement index, and accuracy improvement. The findings of this study suggest that the curriculum leap-up can be an effective teaching strategy for elementary and middle school students in special education resource rooms who are not making gains on lower level materials. Leap-ups to skills with initially high error rates generally produced faster learning as measured by celeration, improvement index, and accuracy improvement.

There is also evidence to suggest that this teaching strategy can benefit students who are making gains on below grade level material. Results indicate that when a student

is experiencing medium to rapid growth on below grade level skills, leap-ups may not accelerate learning above the preleap-up phase, but can produce medium to high rate learning on the leap-up skill.

There were also some indications of "learning to learn" and "learning to teach" occurrences during these experiments. In three cases in particular students and teachers did better decelerating errors on each successive leap-up.

Fluency. In looking across all the frequency multipliers (see Table 4) for the preleap, during, and leap-up phases, fluency for correct responses was split fairly evenly between the preleap and during phases compared with the leap-up phases. In over half, the fluency for the errors reached zero across the preleap-up, during, and leap-up phases. In the remaining leap-ups fluency was generally in favor of the preleap-up phases. Achieving fluency is a matter of how long the leap-up continues. In some cases the student failed to reach higher fluency on the leap-up skill because the teacher dropped the skill as soon as the data stabilized. This was often due to time limitations in the classroom and the fact that the leap-up was done specifically for experimental purposes. There was no difference in fluency for the leap-ups across low growth and below grade level leap-ups.

Leap and Leave Design

Celeration, improvement index, and accuracy improvement. The findings from this group of experiments indicate that skills that have an initially higher error rate (10% more than correct responses) generally produce higher rates of learning than those which begin with lower initial error rates. There was no difference in the results across Low Growth leap-ups and Below Grade Level leap-ups. These findings suggest that students in special education resource rooms should be given tasks with errors initially above the correct responses when they are making slow gains on skills with low or no errors or when they are working on skills below their grade level with low to medium rates of learning.

Fluency. The frequency multipliers for fluency (see Table 7) indicate that fluency for corrects was generally better in the preleap-up phases than in the leap-up phases. The fluency for errors was the same in all but one leap-up. This indicates that the errors in all but the one leap-up reached 0. Again, in many cases the fluency on the correct responses in the leap-up phases was not higher because of the fact that the primary purpose of the investigation was to look for learning rates. Once it was established that the student could learn the skill rapidly, the teacher often dropped it and tried another skill. Fluency was not affected by the type of leap-up (Low Growth or Below Grade Level).

Summary

Both the Leap and Keep and Leap and Leave experiments generally produced higher rates of learning during the leap-up phases. While three leap-ups did not get results, many of the leap-ups do show large differences on the learning measure comparisons. These findings could have significant implications for the education of handicapped learners. Probably some proportion of all handicapped learners' curriculum should be high initial error instruction.

Replications

One reason replications are done is to demonstrate the reliability and generality of data (Tawney and Gast, 1984). Another reason is that replications reduce the scientists' margin of error and insure that the findings can withstand repeated tests (Sidman, 1960). In this investigation, replications were done across subjects, teachers, skills, and settings within each experimental design as described in Chapter 4.

For the Leap and Keep designs three leap-ups failed to replicate the results of higher rates of learning that were generally found for the other 13 leap-ups in the study. There are at least two possible explanations for this failure to replicate. First, the initial celerations for correct responses and errors for these leap-ups were already high. Second the same teacher taught the same learner all

three leap-up skills. The data indicate that she had some trouble teaching to errors in the leap-up phases.

Replications Across Leap and Keep and Leap and Leave Designs

Generally, higher rates of learning during the leap-up phases were found for both the Leap and Keep and the Leap and Leave designs. This replication across designs serves to strengthen confidence in the findings of the less powerful Leap and Leave design.

Replications With Studies Already in the Literature

Subjects in this study generally experienced steeper learning rates under the initially high error rate condition. One of the early studies on learning rates from precision teaching (Neely, 1978) found that error deceleration rates were greater when students were given tasks on which they were making at least 5 to 10 errors per minute. No differences in correct celeration rates were found. However, Neely introduced the idea that crossover learning pictures (with initial error frequencies above correct responses) could produce steeper celerations for correct responses. McGreevy (1980) became interested in the concept that tasks with initially high errors could produce steeper learning and introduced the idea of "hard to do," "easy to learn." He studied the learning of a severely retarded teenager on a vocabulary task with the initial error frequency above the correct responses. The student

achieved rapid acceleration for correct responses and rapid deceleration for errors on the task. Bower and Orgal (1981) taught college students psychology terms on which they initially made many more errors than corrects. Their rates of learning were steep for both corrects and errors. Stromberg and Chappell (1980) taught a second grade class math tasks on which they made little or no initial errors. He then gave them a leap-up to all the math operations in the curriculum to learn at one time. The students' initial error frequencies were very high for the leap-up math tasks, but their rate of learning was much better than it had been on the easier math tasks. Eaton and Wittman (1982) found the learning rates for three junior high school mildly handicapped students could be accelerated by giving them math leap-ups to skills with initially high error rates.

This investigation studied the learning rates of mildly handicapped students in resource rooms who were given math and reading leap-ups. Results replicated across subjects, teachers, skills, and settings generally found higher learning rates on skills with at least 10% more errors than correct responses compared with skills that had initially very low error rates. These results replicate the findings in the above studies and add a new sample population and different skills.

Practical Implications

May students fail to make gains in special education classes (Glazzard, 1984). These classes often focus on skills with initially low error rates so that students can experience success. There is also evidence that the type of instruction used in the majority of classrooms may fail to challenge the learner or to give them skills that will generalize to mainstream classes (Glazzard, 1984).

Further, some teaching strategies that have come from applied behavior analysis, like task analysis (Eaton and Wittman, 1982; Howell, Kaplan, & O'Connell, 1981) or errorless learning may be overused with handicapped learners. The steps in task analysis can be made so excrutiatingly small that the student becomes bored with learning the task. Errorless learning, while an excellent teaching method, does not allow students to experience the learning that comes from viewing errors as learning opportunities (Alberto & Troutman, 1982). The results of overusing these strategies may be that we are producing passive learners who become bored with easy unchallenging tasks or don't know how to learn from errors.

The use of the high error teaching strategy offers many benefits to classroom teachers and their students. These are discussed below along with some guidelines.

Benefits

Results from this study indicate that when teachers use the leap-up teaching strategy students rate of learning may increase. Students tend to become more active learners and teachers become involved in actually teaching skills on which students need instruction rather than just practice.

From a practical point of view, special education students who are behind in school need to be taught using teaching strategies that promote high rate learning. This is the only way that they can hope to catch up with their peers and/or reach any level of competency in basic skills when they complete their education. It is apparent that we must not be content to see these students fall further, and further behind grade level skills as they progress through special education programs.

As evidenced in these experiments, by teaching students to accept making many errors when they begin to learn a new skill, it is possible to accelerate learning and to move students closer to grade level skills. Students appear to be motivated by learning more difficult skills and skills closer to those that their peers are learning. Leap-up strategies may be a contribution to the successful main-streaming of mildly handicapped students.

Also, these findings may have implications for school psychologist and placement committee members responsible for developing IEP's for handicapped students. The tendency is to write long and short term objectives for students which

emphasize skills with fairly high initial accuracy rates. While this may be done to "let the student experience success," educators should be aware that tasks with initially high error rates must also be included in a student's program in order to insure that maximum learning is taking place and that the student is getting experience in learning from errors.

Guidelines

The high error teaching strategy is one way to accelerate the learning of skills for those students who are making slow progress and/or who are working on skills below their grade level placement. However, it would probably not be appropriate to go overboard on leap-ups. More work is needed to determine what proportion of the curriculum should be initially high error rate skills. Also, more ways to reduce errors rapidly need to be developed and ways of overcoming learner resistance to making errors need to be explored before the high error teaching strategy can be fully appreciated.

Problems and Limitations of the Study

One problem appeared during the course of this study. This was due to the fact that many of the practicum teachers were young and inexperienced. They received little or no support from their directing teachers in using the leap-up teaching strategy. They were eager to become involved in

the leap-up experiments, but were reluctant to take the chance of leaping their students to skills with very high error rates. Many of them were concerned that the students still needed practice on the lower level skills and would "miss out on learning." It was interesting to note, however, as they became involved in the experiments two things happened. First, they became excited about the learning taking place on the leap-up skills and actually felt they were teaching instead of just providing opportunities for practice. Second, they began to defend the leap-up concept to their directing teachers and wanted to cease teaching the lower level skills.

A limitation of this study was that the leap-ups generally consisted of math skills, and of reading vocabulary skills. This was because these skills were the easiest to define and were the skills being taught in the practicum sites. A problem was found in trying to do leap-ups on oral reading. Because of the connecting words in oral reading it was very difficult to meet the high initial error rate criterion. The error rate was only achieved for one leap-up and this entailed leaping a student from first grade reader to a college level text book. It may be that the leap-up concept will have to be defined more precisely for a broader range of skills.

Recommendations for Future Research

The curriculum leap-up is an effective teaching strategy when used as part of the instructional approach with mildly handicapped learners. Future research on curriculum leap-ups should focus on five areas: (1) the effects of longer leap-up phases on fluency, (2) chunk-ups, (3) the effects of step-size on learning rates in leap-up phases, (4) strategies for reducing errors, and (5) procedures for reducing anxiety and overcoming resistance to errors.

Longer Leap-Up Phases and Fluency

In this investigation the major concern was rate of learning under leap-up conditions compared with preleap-up conditions. Many of the leap-up phases were short. Future research should focus on the attainment of fluency following a leap-up. Since fluency is dependent on time, the leap-up phases would have to be lengthened and strategies that build fluency could be blended with the error reduction procedures.

Chunk-Ups

A second suggestion for future research is on the concept of chunk-ups. Chunk-ups are special cases of leap-ups. They involve adding more unique problems or units to the teaching set. For example, if a student usually is

given 10 words per week, he could be given a chunk-up to 20 words per week.

Chunk-ups are related to leap-ups in that the student is expected to learn more at one time. The idea is that if the same rate of learning or a faster rate of learning is noted then the "chunk-up" is way of expediting learning for students who need to catch up or who are challenged by learning more at one time.

This investigation intended to study the chunk-up concept. However, preliminary work with chunk-ups led to some problems. Specifically, (1) the chunk-up was not empirically defined in such a way that the concept could be easily understood by those trying to explore its value and (2) there was resistance on the part of the practicum teachers and the directing teachers to try the strategy. Reports from the practicum teachers indicated that directing teachers felt that the chunk size that they were already using was adequate. They were not interested in exploring learning under large chunk conditions.

The small amount of data that was obtained did not show clear enough evidence of control to warrant conclusions about the effectiveness of chunk-ups. Recently, teachers who have tried chunk-ups have reported informally that it is working effectively as a teaching strategy. This concept should be studied further and documented more carefully.

Step Size

Step is a measure of the immediate change in the frequency for correct responses and errors when a new phase begins. In going from the preleap-up to the leap-up phase a step down in correct responses and a step up in errors occurs. Further research should focus on the size of these steps and their correlation with learning rates in leap-up phases.

McGreevy et al. (1982) have already looked at the effect on variability of learning within a range of difficult tasks and found little differences. This research would extend his conclusions by looking at the rate of learning within a range of step sizes.

Strategies for Reducing Errors

Effective strategies for reducing errors rapidly need to be explored. Current behavior analysis research on new ways to reduce errors using stimulus control procedures give hope that new tools may be developing in this area.

Anxiety and Resistance to Errors

At present teachers, parents, and learners are often reluctant and anxious about learning a task that generates high initial errors. Previous experience, with errors viewed as failures, may account for large part of this resistance. Research needs to focus on ways to help individuals view high initial errors as "learning

opportunities." Handicapped persons may produce more than expected errors in their "natural" interaction with the world. It may be especially important for them to learn how to cope with, and keep trying through, the stage of initially high error production.

APPENDIX A

DEFINITION OF TERMS

Standard Glossary and Charting Procedures

Accelerating Target--a movement the behaver, manager, advisor, or supervisor expects to accelerate; the frequency is symbolized by placing a dot on the Chart.

Accuracy Improvement--a measure of change in accuracy over time; celeration correct/celeration incorrect.

Accuracy Multiplier--measure of accuracy: frequency correct/frequency incorrect; distance from frequency incorrect to frequency correct; also called the accuracy ratio.

Accuracy Pair--two movements, usually correct and incorrect, charted simultaneously.

Add-Subtract Scale--any measurement scale on which adding and subtracting by a constant amount is represented by a constant distance; the "up the left" scale on a equal interval chart.

Advisor--person who advises a manager, usually viewing Charts on a weekly basis.

Behaver--person whose behavior is displayed on the Chart.

Behavior Floor--the lowest daily frequency possible for a particular behavior; 1/number of minutes behavior can occur; symbolized by drawing a solid horizontal line on the Chart.

Bounced Around Celeration up bounce and down bounce combined; the range of deviations of frequencies from the celeration line.

Celeration--basic unit of measurement of behavior change; change in frequency per unit time.

Celeration Aim--the expected celeration for a given movement.

Celeration Line--straight line constructed through continuous frequencies for a given movement on the Standard Behavior Chart. For purposes of this investigation, celeration lines were drawn using the quarter intersect method (White & Haring, 1980).

Celeration Multiplier (turn up or turn down)--value by which one celeration is multiplied or divided to obtain a second.

Change Day--first day of a phase change; symbolized by drawing a vertical line covering that day line on the Chart.

Change Line--A line to demark a change of instructional conditions. Goes in the space before first day of new condition.

Chunk--Change in frequency per week. Number of units in the teaching set.

Counting Period Ceiling--the highest frequency observable under a given counting procedure; symbolized by drawing a dash line on the Chart connecting the Saturday and Monday lines.

Counting Period Floor--the lowest frequency detectable by a given counting procedure; 1/number of minutes spent counting; symbolized by drawing a dash line on the Chart connecting the Tuesday and Thursday lines.

Cycle--distance on the Chart between consecutive powers of 10.

Day line--vertical line on the Daily Standard Behavior Chart.

Decelerating Target--a movement the behaver, manager, advisor, or supervisor expects to decelerate; the frequency is symbolized by placing an "x" on the Chart.

Double Improvement Learning Picture--both movements of an accuracy pair with celerations in the expected direction; for example.

Down Bounce--the distance from the celeration line to the frequency farthest below it.

Duration--the amount of time it takes to complete one occurrence of a behavior; 1/number of minutes spent behaving.

Errorless learning--a teaching procedure in which cues and prompts are arranged so as to occasion only correct responses.

Event-Following Celeration Line--a celeration line drawn through all frequencies for a given movement just prior to a phase change.

Fluency--final performance for correct responses and errors.

Freehand Method--a method of visually estimating and drawing celeration lines.

Frequency--basic unit of behavioral measurement; the number of movements per unit time.

Frequency Aim--the expected phase-ending frequency for a given movement; symbolized by drawing "A" at the expected frequency on the day the aim was set.

Frequency Line--a horizontal line on the Chart; also called a counting line.

Frequency Multiplier (jump up or jump down)--value by which one frequency is multiplied or divided to obtain a second.

Geometric Mean--the appropriate method for obtaining an average on a multiply-divide scale.

Ignored Day--a day on which the behavior being measured occurs but is not charted.

Latency--the amount of time between the occurrence of a signal and the beginning of a movement; 1/time from signal to start of movement.

Learning--a change in performance per unit time, also called celeration.

Learning Picture--the celeration lines of both movements of an accuracy pair viewed together; for example.

Manager--person who works with the behaver on a daily basis.

Median Celeration--the middle celeration in a celeration distribution; symbolized by drawing a "<" on the Chart.

Median Frequency--the middle frequency in a frequency distribution; symbolized by drawing a "<" on the Chart.

Most Recent Celeration Line--a celeration line drawn through the last 7-10 frequencies for a given movement.

Movement--recorded behavioral event; usually specified in terms of a movement cycle with a beginning, middle and end.

Multiply-divide Scale--any measurement scale on which multiplying and dividing by a constant amount is represented by a constant distance; the "up the left" scale on the Standard Behavior Chart.

No Chance Day--a day on which the behavior being measured has no chance to occur.

Overall Celeration Line--a celeration line drawn through all frequencies for a given movement.

Performance--the number of movements per unit time; also called frequency.

Periodic Celeration Line--a celeration line drawn through all frequencies for a given movement in a specific time period such as bi-weekly or monthly.

Phase--A period in which a particular set of conditions is in effect.

Phase Change--a deliberate alternation made to the behaver's environment in an effort to improve the behavior being measured.

Precision Teaching--a comprehensive instructional system for accelerating learning and maintaining high proficiency, based on direct and continuous meas procedures.

Quarter-Intersect Method--a method for computing and constructing celeration lines.

Recorded Day--a day on which the behavior being measured as the opportunity to and is recorded.

Single Improvement Learning Picture--one movement of an accuracy pair with a celeration in the expected direction; for example.

Split-middle Line--a line drawn parallel to a quarter-intersect celeration line, such that half the data points fall on or above the line and half the data points fall on or below the line.

Standard Behavior Chart--a standard, six-cycle semi-logarithmic chart that measures frequency as movements/time and celeration as movements/time/time; Daily, Weekly, Monthly, Yearly and Summary versions are available; also called the Standard Celeration Chart.

Step--the ratio between the frequency of two learning lines that intersect the same change line.

Supervisor--a person who views the Charts on a monthly basis.

Total Bounce--distance from the highest to the lowest frequency; analogous to range of an add-subtract scale.

Trend-following Celeration Line--a celeration line drawn through visible trends for a given movement.

Up Bounce--distance from the celeration line to the frequency farthest above it.

APPENDIX B

ALACHUA COUNTY CRITERIA FOR ELIGIBILITY IN LEARNING DISABILITY, EMOTIONALLY HANDICAPPED, AND EDUCABLY MENTALLY RETARDED CLASSES

SPECIFIC LEARNING DISABILITIES

Specific Learning Disabilities--one who exhibits a disorder in one (1) or more of the basic psychological processes involved in understanding or in using spoken and written language. These may be manifested in disorders of listening, thinking, reading, talking, writing, spelling, or arithmetic. They do not include learning problems which are due primarily to visual, hearing, or motor handicaps, to mental retardation, emotional disturbance, or to an environmental deprivation.

Criteria for Eligibility

A student is eligible if the following criteria are met:

a. Evidence of a disorder in one (1) or more of the basic psychological process areas. Basic psychological process areas include visual, auditory, motor and language processes.

   Only tests or subtests appropriate for the student's chronological age shall be used for placement purposes. Hereafter, the Illinois Test of Psycholinguistic Abilities shall be abbreviated as ITPA; the Detroit Tests of Learning Aptitude as DTLA. Required batteries appropriate to age and by process cluster are as follows:

   (1) Chronological ages 5.0 through 10.0

   (a) Visual

   ITPA Reception
   ITPA Association
   ITPA Closure
   ITPA Memory
   ITPA Manual Expression

   (b) Auditory

   ITPA Reception
   ITPA Association
   ITPA Grammatic Closure
   ITPA Memory
   ITPA Verbal Expression

   (c) Visual Motor

   Beery Developmental Test of Visual - Motor Integration (Beery)
   Bender Motor Gestalt Test

(2) Chronological ages above 10.0

(a) Visual

DTLA Memory for Objects
DTLA Memory for Letters
DTLA Disarranged Pictures

(b) Auditory

DTLA Memory for Words
DTLA Memory for Sentences
DTLA Verbal Opposites
DTLA Oral Directions

(c) Visual Motor

Beery
DTLA Memory for Design

Disorders shall be defined according to the instructions of each test's author(s).

b. Evidence of academic achievement which is significantly below the student's level of intellectual functioning.

(1) For students below age seven (7), evidence must be presented that the student exhibits a discrepancy of one (1) standard deviation or more between an intellectual standard score and an achievement standard score(s) in thinking, reading, talking, writing, spelling or arithmetic. Students with deficits in reading, arithmetic, and/or spelling may be considered for exceptional student placement if other applicable criteria are met. Students with deficits in other areas may be offered consultative services.

(2) For students ages seven (7) through ten (10), evidence must be presented that the student exhibits a discrepancy of one (1) standard deviation or more between an intellectual standard score and academic standard score(s) in reading, writing, arithmetic or spelling.

(3) For students ages eleven (11) and above, evidence must be presented that the student exhibits a discrepancy of one and one-half (1 1/2) standard deviations or more between an intellectual standard score and academic standard score in reading, writing, arithmetic or spelling.

(4) For students ages seven (7) and above with deficits in reading, arithmetic, and/or spelling, exceptional student placement may be considered if other applicable criteria are met.

(5) If more than one academic instrument is used to document a weakness, the results must consistently show deficits in the same academic area. If more than one level of functioning is obtained, the mean level of functioning will be used to establish a deficit.

(6) For eligible students functioning at or above their current grade levels, consultative services may be offered.

c. Evidence that learning problems are not due primarily to other handicapping conditions.

(1) For students with intellectual deficits, evidence that intellectual functioning is no more than one (1) standard deviation below the mean on an individual test of intellectual functioning, or evidence that a score below one (1) standard deviation below the mean is not a reliable indicator of the student's potential. Intellectual functioning will be determined by the use of the full scale score derived from the standard battery instrument.

(2) For students with visual processing deficits, evidence that visual acuity is at least 20/70 in the better eye with best possible correction, or evidence that the student's inability to perform adequately on tasks which require visual processing is not due to poor visual acuity.

(3) For students with auditory processing or language deficits, evidence that the loss of auditory acuity is no more than 30 decibles in the better ear unaided or evidence that the student's inability to perform adequately on tasks which require auditory processing of language is not due to poor auditory acuity.

(4) For students with a motor handicap, evidence that their inability to perform adequately on tasks which assess the basic psychological process is not due to the motor handicap.

(5) For students with an emotional handicap, evidence that their inability to perform adequately on tasks which assess the basic psychological processes is not due to the emotional handicap.

d. Documented evidence which indicates that general educational alternatives have been attempted and found to be ineffective in meeting the student's educational needs.

EMOTIONALLY HANDICAPPED

Emotionally Handicapped--one, who after receiving supportive educational assistance and counseling services available to all students, still exhibits a persistent and consistent severe emotional handicap which consequently disrupts the student's own learning process. This is the student whose inability to achieve adequate academic progress or satisfactory interpersonal relationships cannot be attributed primarily to physical, sensory or intellectual deficits. This term does not include children who are socially maladjusted unless it is determined that they are also emotionally handicapped.

Severely Emotionally Disturbed--one who meets the criteria stated above and, in addition, requires a special program for the full school week and extensive supportive services.

1. Criteria for Eligibility

a. Emotionally Handicapped

(1) Evidence that the student, after receiving appropriate supportive educational assistance and counseling, still exhibits a severe emotional handicap.

(2) Evidence that the student exhibits a persistent and consistent severe emotional handicap as determined by documented observations and psychological evaluation.

(3) Evidence that the behavior disrupts the student's ability to achieve adequate academic progress or develop satisfactory interpersonal relationships.

(4) Evidence that the primary problem of the student cannot be attributed primarily to physical, sensory, or intellectual deficits.

b. Severely Emotionally Disturbed

In addition to the criteria stated above in (1) through (4), the following shall be used to determine each student's eligibility:

(1) Evidence that the student requires a program for the full school week which provides a highly structured cognitive and affective curriculum; individual or group counseling and parent counseling or education; and

(2) Evidence that a program provided in a less restrictive environment has not met the individual student's needs.

EDUCABLE MENTALLY HANDICAPPED

Educable Mentally Handicapped--one who is mildly impaired in intellectual and adaptive behavior and whose development reflects a reduced rate of learning. The measured intelligence of an educable mentally handicapped student generally falls between two (2) and three (3) standard deviations below the mean, and the assessed adaptive behavior falls below age and cultural expectations.

Criteria for Eligibility

a. The measured level of intellectual functioning, as determined by performance on an individual test of intelligence, is between two (2) and (3) standard deviations below the mean. The standard error of measurement may be considered in individual cases. The profile of intellectual functioning shows consistent sub-average performance in a majority of areas evaluated.

b. The assessed level of adaptive behavior is below age and cultural expectation.

c. Sub-average performance on a standardized measure of academic achievement is demonstrated.

APPENDIX C

DECISION AND OUTCOME FORM

Teaching & Learning DECISIONS & OUTCOMES

Teacher_____ Setting_____ Dates_____to_____

Learner_____ M F Age_____ Program_____

Skill Name_____

** Skill Description **

Phase	Learning Channel	Limits of Class	Number in Set	Aim Focus	# Related Skills	Performance Standard
1						
2						
3						
4						

** Decisions and Actions **

	Learning Picture*	Decision Rule(s) Used	Describe Changes Made or Record Comments or Questions
1			
2			
3			
4			

* Learning pictures need minimum of five data points.

>>> DECISION RULES: [1] At aim for 1 day confirmed [2] Three days flat data [3] Minimum celeration < X1.25 for corrects [4] Corrects decelerating [5] Less than previously projected celeration (5 days) [6] Other

** Outcome Data **

	Number Timings	Last Day Freqncy#		First Day Freqncy#	Frequency Change	Celeration for Phase	# Days	Prf Stnd Achvd
1			C			X ÷		Yes No
			E			X ÷		
2			C			X ÷		Yes No
			E			X ÷		
3			C			X ÷		Yes No
			E			X ÷		
4			C			X ÷		Yes No
			E			X ÷		

Frequncies from intersections of learning line with last and first days

APPENDIX D

RAW DATA: CORRECT AND INCORRECT FREQUENCIES FOR ALL PHASES OF THE LEAP AND KEEP AND LEAP AND LEAVE DESIGNS

Appendix D: Part A: Leap and Leave Experiments

Learner: E B Teacher: Investigator

Movement Cycle: See--Say Texted Words

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	>>>>>>>>>>>>>>>>>>>>>>>		
	2	89	0
	3	96	0
	4	100	0
	5	109	0
	6	110	0
Leap-Up	>>>>>>>>>>>>>>>>>>>>>>>		
	7	9	11
	8	24	3
	9	57	4
	10	64	2
	11	72	2

Appendix D: Part A: Leap and Leave Experiments

Learner: E B Teacher: Investigator

Movement Cycle: See--Say Vocabulary Words

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	>>>>>>>>>>>>>>>>>>>>>>>>		
	5	72	0
	6	80	0
	7	95	0
	8	87	0
	9	NC	NC
	10	101	0
	11	100	0
	12	101	0
	13	100	0
Leap-Up	>>>>>>>>>>>>>>>>>>>>>>>>		
	14	3	12
	15	31	5
	16	40	5
	17	49	2
	18	NC	NC
	19	54	0
	20	NC	NC
	21	58	0
	22	72	0

Appendix D: Part A: Leap and Leave Experiments

Learner: L A Teacher: W O
Movement Cycle: See--Write Add Facts, sums to 18

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	>>>>>>>>>>>>>>>>>>>>>>		
	3	34	0
	4	43	1
	5	48	0
	6	NC	NC
	7	NC	NC
	8	40	0
	9	59	0
	10	59	0
	11	48	2
	12	68	0
Leap-Up #1	>>>>>>>>>>>>>>>>>>>>>>		
	36	0	4
	37	NC	NC
	38	7	0
	39	9	0
	40	9	0
	41	NC	NC
	42	NC	NC
Leap-Up #2	>>>>>>>>>>>>>>>>>>>>>>		
	43	3	6
	44	NC	NC
	45	13	0
	46	16	0
	47	13	0
	48	NC	NC
	49	NC	NC
	50	22	0
	51	NC	NC
	52	NC	NC
	53	NC	NC
	54	NC	NC
	55	NC	NC
	56	NC	NC
LEAP-UP #3	>>>>>>>>>>>>>>>>>>>>>>		
	57	0	15
	58	2	0
	59	5	0
	60	5	0
	61	7	0

Appendix D: Part A: Leap and Leave Experiments

Learner: W T Teacher: J R

Movement Cycle: See--Write Add Facts, sums to 6

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	> > > > > > > > > > > > > > > > > > > >		
	3	24	0
	4	19	2
	5	NC	NC
	6	NC	NC
	7	NC	NC
	8	31	0
	9	NC	NC
	10	NC	NC
	11	24	0
	12	NC	NC
	13	NC	NC
	14	NC	NC
Leap-Up #1	> > > > > > > > > > > > > > > > > > > >		
	15	0	24
	16	8	0
	17	0	0
	18	0	6
	19	NC	NC
	20	NC	NC
	21	NC	NC
	22	NC	NC
	23	24	0
	24	26	0
	25	28	0

Appendix D: Part A: Leap and Leave Experiments

Learner: R J Teacher: S B

Movement Cycle: See--Write Add Facts, sums to 18

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	> > > > > > > > > > > > > > > > > > >		
	5	50	0
	6	NC	NC
	7	NC	NC
	8	NC	NC
	9	NC	NC
	10	54	1
	11	54	0
	12	52	0
	13	NC	NC
	14	NC	NC
	15	55	0
	16	NC	NC
	17	65	1
	18	73	0
	19	74	0
	20	NC	NC
	21	NC	NC
	22	71	0
	23	NC	NC
	24	73	0
	25	76	0
	26	NC	NC
	27	NC	NC
	28	NC	NC
	29	77	0
	30	NC	NC
	31	83	0
	32	NC	NC
	33	NC	NC
	34	NC	NC
	35	NC	NC
	36	79	0
	37	NC	NC
	38	84	0
Leap-Up #1	> > > > > > >	> > > > > > > > > > > > >	
	53	6	16
	54	33	4
	55	37	2
	56	NC	NC
	57	NC	NC
	58	54	0
	59	NC	NC
	60	62	0

R J (Continued)

61	62	0
62	69	0
63	NC	NC
64	NC	NC
65	72	0
66	NC	NC
67	77	0

Appendix D: Section A: Leap and Leave Experiments

Learner: O S Teacher: B M
Movement Cycle: See--Write Add Facts, sums to 18

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up			
	1	42	0
	2	48	0
	3	49	0
	4	50	0
	5	51	0
	6	NC	NC
	7	NC	NC
	8	52	0
	9	52	0
	10	53	0
Leap-Up			
	11	1	72
	12	6	33
	13	NC	NC
	14	NC	NC
	15	11	21
	16	12	15
	17	NC	NC
	18	8	4
	19	1	1
	20	NC	NC
	21	NC	NC
	22	NC	NC
	23	14	2
	24	17	3
	25	21	2
	26	NC	NC
	27	NC	NC
	28	NC	NC
	29	15	0

Appendix D: Section A: Leap and Leave Experiments

Learner: J R Teacher: B M

Movement Cycle: See--Write Add Facts, sums to 10

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	>>>>>>>>>>>>>>>>>>>>>>>>>		
	2	25	3
	3	20	3
	4	22	1
	5	25	3
	6	NC	NC
	7	NC	NC
	8	28	1
	9	NC	NC
	10	NC	NC
	11	NC	NC
	12	NC	NC
	13	NC	NC
	14	NC	NC
	15	27	0
	16	30	0
	17	33	1
	18	33	0
	19	NC	NC
	20	NC	NC
	21	NC	NC
Leap-Up	>>>>>>>>>>>>>>>>>>>>>>>>>		
	22	2	5
	23	3	6
	24	7	0
	25	8	0
	26	NC	NC
	27	NC	NC
	28	NC	NC
	29	NC	NC
	30	10	0
	31	11	0
	32	13	0
	33	15	0

Appendix D: Section A: Leap and Leave Experiments

Learner: A F Teacher: W O
Movement Cycle: See--Write Subtraction Facts

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up >>>>>>>>>>>>>>>>>>>>			
	4	17	1
	5	26	0
	6	NC	NC
	7	NC	NC
	8	28	0
	9	31	0
	10	33	0
	11	37	0
	12	NC	NC
	13	NC	NC
	14	NC	NC
	15	38	0
	16	37	0
	17	NC	NC
	18	41	0
	19	45	0
	20	NC	NC
	21	NC	NC
	22	45	0
	23	47	0
	24	NC	NC
	25	NC	NC
	26	NC	NC
	27	NC	NC
	28	NC	NC
	29	NC	NC
Leap-Up >>>>>>>>>>>>>>>>>>>>>>			
	30	2	4
	31	3	0
	32	5	1

Appendix D: Section A: Leap and Leave Experiments

Learner: R V Teacher: B M

Movement Cycle: See--Write Mixed Math Facts

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	>>>>>>>>>>>>>>>>>>>>>>>>		
	5	31	0
	6	NC	NC
	7	NC	NC
	8	33	0
	9	36	0
	10	33	0
	11	39	0
	12	NC	NC
	13	NC	NC
	14	NC	NC
	15	40	0
	16	42	0
	17	NC	NC
	18	44	0
	19	45	0
	20	NC	NC
	21	NC	NC
Leap-Up	>>>>>>>>>>>>>>>>>>>>>>>>>		
	22	0	11
	23	22	1
	24	27	0
	25	NC	NC
	26	34	0

Appendix D: Section A: Leap and Leave Experiments

Learner: C B Teacher: B M

Movement Cycle: See--Write Multiplication Facts, X 4 table

Phase Name	Calendar Day #	Frequency Correct	Frequency Errors
Preleap-Up	>>>>>>>>>>>>>>>>>>>>>>>		
	1	8	0
	2	11	2
	3	12	0
	4	12	0
	5	NC	NC
	6	NC	NC
	7	NC	NC
	8	NC	NC
	9	13	0
	10	12	0
	11	NC	NC
	12	11	1
	13	NC	NC
	14	NC	NC
	15	14	0
	16	14	1
	17	14	0
	18	15	0
	19	16	0
	20	NC	NC
	21	NC	NC
	22	18	0
Leap-Up #1	>>>>>>>>>>>>>>>>>>>>>>>		
	23	2	6
	24	NC	NC
	25	6	1
	26	NC	NC
	27	NC	NC
	28	NC	NC
	29	NC	NC
	30	NC	NC
	31	8	2
	32	5	3
	33	7	60
	34	NC	NC
	35	NC	NC
	36	8	0
	37	9	0
	38	12	1
	39	13	0
Leap-Up #2	>>>>>>>>>>>>>>>>>>>>>>>		
	46	4	73
	47	NC	NC
	48	NC	NC
	49	2	50
	50	4	55

C B (Continued)

51	9	38
52	NC	NC
54	NC	NC
55	NC	NC
56	NC	NC
57	9	18
58	13	16
59	NC	NC
60	14	1
61	17	0
62	NC	NC
63	NC	NC
64	NC	NC
65	NC	NC
66	18	0
67	29	3

Appendix D: Part B: Leap and Keep Experiments

<u>Learner:</u> W T <u>Teacher:</u> J R

<u>Movement Cycle:</u> See--Say Alphabet

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>>						
	1	12	9			
	2	21	5			
	3	22	4			
	4	19	7			
	5	20	6			
	6	NC	NC			
	7	NC	NC			
	8	21	5			
	9	26	5			
	10	25	3			
	11	21	5			
During >>>>>>>>>>>>>>>>>>>>>>>>				Leap-Up #1 >>>>>>>>>>>>>>>		
	12	NC	NC		3	11
	13	NC	NC		NC	NC
	14	NC	NC		NC	NC
	15	24	3		6	8
	16	27	3		8	8
	17	19	1		9	8
	18	30	2		11	8
	19	29	0		6	8
	20	NC	NC		NC	NC
	21	NC	NC		NC	NC
	22	30	0		15	7
	23	NC	NC		NC	NC
	24	NC	NC		NC	NC
	25	31	0		14	4
	26	NC	NC		NC	NC
	27	NC	NC		NC	NC
	28	NC	NC		NC	NC
	29	32	0		15	3
	30	36	0		15	3
	31	38	0		16	4
	32	41	0		17	3
	33	44	0		NC	NC
	34				NC	NC
	35				NC	NC
				Leap_up #2 >>>>>>>>>>		
	36				0	10
	37				5	11
	38				0	18
	39				6	10
	40				NC	NC
	41				NC	NC
	42				NC	NC
	43				NC	NC
	44				9	8

W T (Continued)

45	10	7
46	16	8
47	18	10
48	NC	NC
49	NC	NC
50	17	7
51	22	5
52	19	5
53	17	4
54	16	6
55	NC	NC
56	NC	NC
57	17	4
58	20	2
59	NC	NC
60	26	2
61	25	1
62	NC	NC
63	NC	NC
64	28	2
65	21	5
66	NC	NC
67	NC	NC
68	NC	NC
69	NC	NC
70	NC	NC
71	26	3
72	28	2
73	NC	NC
74	24	3
75	30	0

Appendix D: Part B: Leap and Keep Experiments

Learner: J V Teacher: S L

Movement Cycle: See--Say Ginn Phrases, level 7

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>>						
	3	56	5			
	4	59	2			
	5	NC	NC			
	6	NC	NC			
	7	NC	NC			
	8	NC	NC			
	9	NC	NC			
	10	NC	NC			
	11	NC	NC			
	12	NC	NC			
	13	NC	NC			
	14	NC	NC			
	15	73	3			
	16	73	0			
	17	79	0			
	18	86	0			
During #1 >>>>>>>>>>>>>>>>>>>>>						
	19	32	7			
	20	NC	NC			
	21	NC	NC			
				Leap-Up #1 >>>>>>>>>>>>		
	22	40	2		8	11
	23	42	0		25	23
	24	45	3		38	6
	25	49	0		40	2
	26	NC	NC		NC	NC
	27	NC	NC		NC	NC
	28	NC	NC		NC	NC
	29	50	3		40	6
	30	53	0		46	2
	31	57	2		51	2
	32	NC	NC		NC	NC
	33	NC	NC		NC	NC
	34	NC	NC		NC	NC
	35	NC	NC		NC	NC
	36	NC	NC		NC	NC
	37	57	4		48	8
	38	60	1		62	4
	39	NC	NC		69	3
	40	64	0		81	3
	41	NC	NC		NC	NC
	42	NC	NC		NC	NC
				Leap-Up #2 >>>>>>>>>>>>>>>		
	42	72	0		17	21
	43	78	4		24	13
	44	76	0		26	4

J V (Continued)

45	93	0	32	8
46	100	0	NC	NC
47	NC	NC	NC	NC
48	NC	NC	NC	NC
During #2 >>>>>>>>>>>>>>>>>>>>				
49	31	6	54	3
50	NC	NC	NC	NC
51	40	3	55	2
52	44	2	60	1
53	46	4	66	0
54	NC	NC	NC	NC
55	NC	NC	NC	NC
56	51	4	68	0
57	76	3	72	0
58	103	3	86	0
59	NC	NC	NC	NC
60	NC	NC	NC	NC
61	NC	NC	NC	NC
62	NC	NC	NC	NC
During #3 >>>>>>>>>>>>>>>>>>>>Leap-Up #3 >>>>>>>>>>>>>>>>>>				
63	28	4	13	15
64	29	6	13	12
65	NC	NC	21	70
66	NC	NC	25	8
67	NC	NC	30	6
68	NC	NC	NC	NC
69	NC	NC	NC	NC
70	32	4	34	8
71	35	2	41	4
72	41	3	45	1
73	46	2	49	0
74	53	1	56	0

Appendix D: Part B: Leap and Keep Experiments

Learner: D P Teacher: C F
Movement Cycle: See--Say Ginn Vocabulary, level 8

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>>						
	5	13	45			
	6	NC	NC			
	7	NC	NC			
	8	17	5			
	9	NC	NC			
	10	NC	NC			
	11	25	3			
	12	36	2			
	13	NC	NC			
	14	NC	NC			
	15	47	0			
	16	NC	NC			
	17	NC	NC			
	18	NC	NC			
	19	NC	NC			
	20	NC	NC			
	21	NC	NC			
	22	NC	NC			
	23	52	3			
	24	NC	NC			
	25	51	1			
	26	55	1			
	27	NC	NC			
	28	NC	NC			
During #1 >>>>>>>>>>>>>>>>>>>>				Leap-Up #1 >>>>>>>>>>>>>>44		
	29	58	1		4	9
	30	NC	NC		13	5
	31	NC	NC		19	3
	32	57	0		27	1
	33	NC	NC		NC	NC
	34	NC	NC		NC	NC
	35	NC	NC		NC	NC
	36	65	0		29	2
During #2 >>>>>>>>>>>>>>>>>>>>						
	37	18	5		30	1
	38	NC	NC		NC	NC
	39	21	4		NC	NC
	40	24	2		34	2
	41	NC	NC		NC	NC
	42	NC	NC		NC	NC
	43	34	2		34	3
	44	39	2		41	3
	45	NC	NC		NC	NC
	46	NC	NC		NC	NC
	47	NC	NC		NC	NC
	48	NC	NC		NC	NC

D P (Continued)

49	NC	NC	NC	NC
50	42	2	40	2
51	49	2	48	3
52	NC	NC	NC	NC
53	56	2	55	2
54			NC	NC
55			NC	NC
56			NC	NC
		Leap-Up #2 >>>>>>>>>>>>>>>>>>		
57			2	8
58			14	3
59			NC	NC
60			NC	NC
61			NC	NC
62			NC	NC
63			NC	NC
64			NC	NC
65			18	2
66			NC	NC
67			23	4
68			29	3
69			NC	NC
70			NC	NC
71			35	2
72			37	2

Appendix D: Part B: Leap and Keep Experiments

Learner: D P Teacher: C F
Movement Cycle: See--Say Ginn Phrases, level 8

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>						
	1	34	3			
	2	55	3			
	3	NC	NC			
	4	68	1			
	5	NC	NC			
	6	NC	NC			
	7	NC	NC			
During >>>>>>>>>>>>>>>>>>>				>Leap-Up >>>>>>>>>>>>>>>>>>>>>		
	8	73	2		8	19
	9	76	2		22	3
	10	88	0		48	1
	11				54	2
	12				NC	NC
	13				NC	NC
	14				NC	NC
	15				60	1
	16				75	1
	17				NC	NC
	18				NC	NC
	19				NC	NC
	20				NC	NC
	21				NC	NC
	22				81	3
	23				115	1

Appendix D: Part B: Leap and Keep Experiments

Learner: N R **Teacher:** S B

Movement Cycle: See Write Add Facts, sums to 18

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>>						
	1	27	1			
	2	NC	NC			
	3	31	2			
	4	21	0			
	5	19	0			
	6	NC	NC			
	7	NC	NC			
	8	31	0			
	9	NC	NC			
During >>>>>>>>>>>>>>>>>>>>				>Leap-Up #1 >>>>>>>>>>>>>>>>>>>>		
	10	33	0		12	23
	11	36	0		NC	NC
	12	NC	NC		NC	NC
	13	NC	NC		NC	NC
	14	NC	NC		NC	NC
	15	35	0		21	1
	16	NC	NC		NC	NC
	17	27	0		34	2
	18	NC	NC		NC	NC
	19	NC	NC		NC	NC
	20	NC	NC		NC	NC
	21	NC	NC		NC	NC
	22	36	0		47	2
	23	NC	NC		NC	NC
	24	33	0		44	0
	25	35	0		52	1
	26	35	0		48	2
	27	NC	NC		NC	NC
	28	NC	NC		NC	NC
	29	36	0		44	2
	30	NC	NC		NC	NC
	31	NC	NC		44	0
	32	NC	NC		49	0
	33	39	0		NC	NC
				Leap-Up #2 >>>>>>>>>>>>>>>>		
	50				0	6
	51				NC	NC
	52				4	1
	53				15	0
	54				20	2

Appendix D: Part B: Leap and Keep Experiments

Learner: C J **Teacher:** S B
Movement Cycle: See-Write Add Facts, sums to 18

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>						
	4	38	0			
	5	39	0			
	6	41	0			
	7	NC	NC			
	8	NC	NC			
	9	44	1			
	10	NC	NC			
	11	45	0			
	12	49	0			
	13	NC	NC			
	14	NC	NC			
	15	NC	NC			
	16	55	0			
	17	NC	NC			
	18	52	1			
	19	44	1			
	20	45	0			
	21	NC	NC			
	22	NC	NC			
During >>>>>>>>>>>>>>>>>>>>>>>				>Leap-Up #1 >>>>>>>>>>>>>>>>>>>>		
	23	49	0		2	16
	24	NC	NC		24	1
	25	55	0		27	0
	26	55	0		30	0
	27	57	1		34	2
	28	NC	NC		NC	NC
	29	NC	NC		NC	NC
	30	59	0		41	0
	31				NC	NC
	32				46	0
	33				37	0
	34				44	0
	35				NC	NC
	36				NC	NC
				Leap-Up #2 >>>>>>>>>>>>>>>>>>>>		
	37				4	16
	38				16	1
	39				NC	NC
	40				NC	NC
	41				17	1
	42				NC	NC
	43				NC	NC
	44				NC	NC
	45				NC	NC
	46				NC	NC
	47				NC	NC
	48				19	0

Appendix D: Part B: Leap and Keep Experiments

Learner: A K Teacher: J R

Movement Cycle: See--Write Add Facts, sums to 10

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>>						
	1	13	0			
	2	8	1			
	3	NC	NC			
	4	13	0			
	5	13	0			
	6	NC	NC			
	7	NC	NC			
	8	NC	NC			
	9	15	0			
	10	16	0			
During >>>>>>>>>>>>>>>>>>>>>>				Leap-Up >>>>>>>>>>>>>>>>>>>		
	11	10	0		0	8
	12	14	0		5	1
	13	NC	NC		NC	NC
	14	NC	NC		NC	NC
	15	13	0		4	0
	16	15	0		6	0

Appendix D: Part B: Leap and Keep Experiments

Learner: Y B   Teacher: B M

Movement Cycle: See--Write Multiplication Facts

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>>						
	1	37	1			
	2	49	0			
	3	51	0			
	4	NC	NC			
	5	53	0			
	6	NC	NC			
	7	NC	NC			
During >>>>>>>>>>>>>>>>>>>>>>				>Leap-Up >>>>>>>>>>>>>>>>>>>>>		
	8	51	0		2	41
	9	55	0		5	53
	10	57	0		7	30
	11	60	0		9	37
	12				NC	NC
	13				NC	NC
	14				NC	NC
	15				NC	NC
	16				11	28
	17				NC	NC
	18				10	21
	19				10	5
	20				NC	NC
	21				NC	NC
	22				10	23
	23				13	4
	24				17	2
	25				19	4
	26				NC	NC
	27				NC	NC
	28				22	2
	29				25	1
	30				25	1
	31				NC	NC
	32				27	0

Appendix D: Part B: Leap and Keep Experiments

<u>Learner:</u> G R <u>Teacher:</u> B M

<u>Movement Cycle:</u> See--Write Multiplication Facts

Phase Name	Calendar Day #	Frequency Corrects	Frequency Errors	Phase Name	Frequency Corrects	Frequency Errors
Preleap-Up >>						
	1	43	0			
	2	52	0			
	3	56	0			
	4	50	0			
				Leap-Up >>>>>>>>>>>>>>>>>>>>>		
	5	NC	NC		0	30
	6	NC	NC		NC	NC
	7	NC	NC		NC	NC
During >>>>>>>>>>>>>>>>>>>>>						
	8	60	0		5	12
	9	64	0		10	21
	10	67	0		13	23
	11	70	0		15	28
	12				19	38
	13				NC	NC
	14				NC	NC
	15				16	13
	16				18	14
	17				25	11
	18				NC	NC
	19				28	2
	20				NC	NC
	21				NC	NC
	22				32	0
	23				NC	NC
	24				38	0
	25				47	0
	26				51	0
	27				NC	NC
	28				NC	NC
	29				59	0
	30				69	0
	31				75	0
	32				80	0
	33				79	1

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BIOGRAPHICAL SKETCH

Michele C. Gerent was born April 23, 1948, in Schenectady, New York. She was graduated from the University of Florida in 1970, with a Bachelor of Arts in Education degree. In 1974, she received a Master of Education degree from Florida Atlantic University at Boca Raton, Florida, with an emphasis in learning disabilities.

She was employed as a special education teacher for a total of 11 years in Palm Beach, Broward, and Indian River County school systems. During those years she taught mentally retarded, emotionally handicapped, learning disabled, and gifted students.

Michele came to the University of Florida in the spring of 1981 to work on a Ph.D in special education. Her major area was learning disabilities with an emphasis in precision teaching and microcomputers in education.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

William D. Wolking, Chairman
Professor of Special Education

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Cecil D. Mercer

Cecil Mercer
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Professor, Department of
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Teacher Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Catherine Morsink
Professor of Special Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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This dissertation was submitted to the Graduate Faculty of the Department of Special Education in the College of Education and to the Graduate School, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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